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PROCEEDINGS OF THE

AMERICAN SOCIETY
OF CIVIL ENGINEERS

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This Journal represents an effort by the Society to deliver information to the reader with the greatest possible speed. To this end the material herein has none of the usual editing required in more formal publications.

Original papers and discussions of current papers should be submitted to the Manager of Technical Publications, ASCE. The final date on which a discussion should reach the Society is given as a footnote with each paper. Those who are planning to submit material will expedite the review and publication procedures by complying with the following basic requirements:

1. Titles should have a length not exceeding 50 characters and spaces.

2. A 50-word summary should accompany the paper.

3. The manuscript (a ribbon copy and two copies) should be double-spaced on one side of 8½-in. by 11-in. paper. Papers that were originally prepared for oral presentation must be rewritten into the third person before being submitted.

4. The author's full name, Society membership grade, and footnote reference stating present employment should appear on the first page of the paper.

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6. Tables should be typed (ribbon copies) on one side of 8½-in. by 11-in. paper within a 6½-in. by 10½-in. invisible frame. Small tables should be grouped within this frame. Specific reference and explanation should be made in the text for each table.

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8. Papers should average about 12,000 words in length and should be no longer than 18,000 words. As an approximation, each full page of typed text, table, or illustration is the equivalent of 300 words.

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Journal of the
BOARD OF DIRECTION
Proceedings of the American Society of Civil Engineers

PROFESSIONAL EARNINGS AND SATISFACTION SURVEY OF CIVIL ENGINEERS

Report of the Junior Activities Committee, Kansas City Section, ASCE
(Proc. Paper 1486)

SUMMARY

A survey was undertaken by the Junior Activities Committee of the Kansas City Section of A.S.C.E. to reveal conditions of satisfaction with employment and salary within the membership of that Section. The results have been plotted to indicate those conditions by age of the employee, by type of work, and by employer group.

There is normally little intent in a salary survey beyond curiosity and a desire to compare ones own conditions with those of others. The survey reported herein, however, represents the culmination of a two-year program of the Junior Activities Committee of the Kansas City Section.

It has been the practice of the Kansas City Section for some time to turn one monthly meeting over to its Junior Members. Two years ago, the committee on Junior Activities made and reported on a study of unions and unionism as they might affect civil engineers, particularly in the Section's area. The following year the committee undertook a survey in an attempt to reveal conditions which might foster the establishment of unions.

The survey questionnaire was sent to 684 members and potential ASCE members in the Kansas City area. An excellent return was obtained as 400 replies were received. The true percentage return is probably higher than this 58.5% since the mailing list included many employers and as the questionnaire was not specifically designed for them the return from this group was apparently very small.

The survey questionnaire, together with a tabulation of the percentage of the answers received to each question, is as follows:

Note: Discussion open until May 1, 1958. Paper 1486 is part of the copyrighted Journal of the Board of Direction of the American Society of Civil Engineers, Vol. 83, No. BD 2, December, 1957.

AMERICAN SOCIETY OF CIVIL ENGINEERS
KANSAS CITY SECTION
JUNIOR ACTIVITIES COMMITTEE

PROFESSIONAL EARNINGS AND SATISFACTION SURVEY OF CIVIL ENGINEERS

The following is a duplication of the questionnaire with the answer to each question expressed as a percentage of the number answering that particular question.

Check or fill in each question. Give only one answer to each question.

GENERAL

1. ASCE grade: Jr. 42% A.M. 30% Member 16% Affiliate 0%
   Non-member 12%

2. Age: yrs. (avg.) 36.8
   32.0 (med.)

3. Degrees: No degree 8% Bachelor 82%
   Master 8% Doctor 1% Other 1%

4. a. Registered: Yes 63% No 13% b. EIT: Yes 17% No 7%

5. Professional experience in years: 1-5 29% 6-10 27% 11-15 12%
   16-20 4% Over 20 28%

6. Principal type of work:

Research	2%	Sales	2%	Management	15%	Plant Operation	1%
Drafting	10%	Design	37%	Estimating	6%	Field Supervision	10%
Teaching	1%	Reports	10%	Specifications	5%	Other	1%

7. Principal field of endeavor:

Government, Federal	13%	State	5%	Local	3%
Construction	15%	Utility	5%	Industrial	7%
Consulting	51%	Other	0%		

8. Are you satisfied with:
   a. Civil Engineering as a profession? Yes 89% No 11%
   b. Professional recognition by:
      (1) Employers? Yes 65% No 35%
      (2) The Public? Yes 39% No 61%
      (3) Other Professions? Yes 44% No 56%
   c. Your own opportunities for advancement? Yes 69% No 31%

SALARY CONSIDERATIONS

9. Engineering earnings in 1955 over

$ 4,000	2%	4,500	4%	5,000	8%		
5,500	8%	6,000	14%	6,500	8%		
7,000	10%	7,500	21%	10,000	19%		
15,000	1%	20,000	4%	50,000	1%		

   Average: $9,140

10. Have you experienced satisfactory salary increases since entering the engineering profession? Yes 69% No 31%

11. How would you prefer to be paid? Monthly Salary 93% Hourly Wage 7%

12. How much do you think you should be earning based upon your experience and qualifications? Average: $10,625

EMPLOYER POLICY

13. Do you feel that you are adequately informed as to your company's management policies and planning for the future? Yes 52% No 48%

14. Does your Employer:
    a. Allow adequate "time-off" for participation in outside technical activities? Yes 79% No 21%
    b. Allow "time-off" for participation in outside civil activities? Yes 66% No 34%
    c. Require "make-up" of such "time-off" periods? Yes 26% No 74%

15. Does your Employer encourage state registration as a professional engineer? Yes 71% No 29%

16. How? Some answers received were:

    Demand.
    Pat on the back.
    Pay expenses and salary during examination.
    Pay technical society membership.
    Used as a basis for determining salary.
    Used as a basis for determining bonus.
    Required for employment.
    Payment of registration fee.
    Payment of annual fee.
    Assists in preparation for examination.
    Registered engineers favored in promotion.
    Frequent requests.
    Verbally

EMPLOYER BENEFITS

17. Does your Employer:
    a. Have a retirement plan? Yes 33% No 67%
    b. Provide a group health insurance plan for employees? Yes 80% No 20%
    c. Have a profit sharing or bonus plan
       (1) For all employees? Yes 42% No 58%
       (2) For engineering employees? Yes 49% No 51%
       (3) Do you participate? Yes 59% No 41%

18. Who pays:
    a. For retirement plan? Employee 24% Employer 27% Both 49%
    b. For health insurance plan? Employee 43% Employer 31% Both 26%

19. Company vacation policy: None 2% 1 week 2% 2 weeks 79%
    3 weeks 5% 4 weeks 9% Other 3%

20. Are you paid for overtime? Yes 54% No 46%

21. Military leave: Paid 40% Unpaid 60%

22. a. Sick leave: Limited 18% Cumulative 34%
Variable 47% Other 1%

b. If not sick, may sick leave time be used for personal business?
Yes 12% No 88%

WORKING CONDITIONS

23. Are you engaged in many daily tasks which could be effectively handled by subordinate personnel? Yes 52% No 48%

24. Does your job provide any opportunity for meeting people in other professions and fields of business? Yes 59% No 41%

25. Has your particular field of interest been recognized by your employer in making job assignments? Yes 82% No 18%

26. Is your job: Inside office work? 50% Field work? 5% Combination? 45%

27. How would you rate the following conditions where you work?

a. Supervision	Good	56%	Fair	36%	Poor	9%
b. Employee-Management Relations	Good	52%	Fair	35%	Poor	14%
c. Variance in Daily Tasks	Good	57%	Fair	34%	Poor	9%
d. Privacy During Work Hours	Good	35%	Fair	31%	Poor	34%
e. Physical Comfort	Good	60%	Fair	29%	Poor	11%

It should be noted that these percentages are figured on the number of replies to a particular question and not to the number of questionnaires returned. This procedure was followed to eliminate the effect of a questionnaire returned by an employer. The question pertaining to the type of work received more than one answer in many instances, even though it was requested that only one answer be given to each question. When it was possible to deduct which type of work was the major endeavor, this answer was included in the percentages; otherwise it was eliminated.

The survey questionnaire was designed to not only provide salary information, but also to indicate extent of, type of, and satisfaction with working conditions. It was felt these items were nearly as important as salary considerations in revealing potential union interest. The questionnaire included questions which, when answered, would permit a segregation of type of work, employer category, and experience to be analyzed together with the answers to the salary and satisfaction questions. The survey results could, therefore, be broken into a great number of comparisons of salary and working conditions by experience, type of work, employer category, type of work within employer category, registration status, education and many combinations thereof.

The results of some of the possible comparisons are illustrated in Figures 1 to 8. It should be remembered, in inspection of these curves, that they do not necessarily represent a trend but rather a graphical representation of conditions at the time of the survey. It is well to also keep in mind that these comparisons reflect conditions only within the geographical area of the Kansas City Section and comparison of the reported data with similar data from other sections of the country would possibly be very misleading without inclusion of certain economic and geographical factors.

The following explanations of each figure are recognized to be conjecture and are not offered as the sole reason for the shape of the curves. Under the

conditions of the survey, however, they represent a reasonable explanation; it is quite possible two or more quite different conditions may cause the same shape of a curve. However, an exhaustive study of the reported data was beyond the scope of the survey.

The answers to question 4 regarding registration are plotted in Figure 1. For this graph, engineer-in-training status was considered as registration. The results are not at all surprising; it was expected that registered engineers would command a higher salary than those not registered and that the difference in salary would increase with experience. Figure 1 shows exactly this.

The results of question 3 on extent of education, as plotted in Figure 2, were a distinct surprise. The fact that the Master's degree curve started below the Bachelor's degree curve was anticipated since the advanced degree requires several years of additional study, and an offset in the curves along the age axis would represent this. The MS curve then rises above the BS curve, which is also expected. The MS curve, dipping below the BS curve, however, was totally unexpected. It was first thought that research and teaching would explain the dip but such employment is not indicated on the returns producing the data for this part of the curve; the work reported is primarily design. Although the number of returns indicating an MS degree is a small percentage of the total number of returns, the number falling on this portion of the curve is 40 per cent of those reporting the MS degree. It is not, therefore, a result of isolated data.

Type of work vs. salary according to age are illustrated in Figures 3a to 3e. These breakdowns by type of work permit an analysis of the individual types as well as comparisons between the types.

Figure 3d shows salary management increases linearly with age and is the highest of the type of work curves, a result not at all unexpected.

In general, the curves of Figure 3 indicate a definite leveling, particularly in those lines of work that have a definite level of knowledge necessary to successfully discharge the duties of that work. The types of work requiring knowledge of new and changing techniques and procedures, as in design, sales, research, and teaching, have either a much higher leveling point or none at all on these charts.

The dip in the design curve is attributed to the number of government employees reporting in the 36-45 age range. The shape of the field supervision curve is probably due to the variety of work that can be classified as field supervision. The general category, "field supervision," has a large range of degree of responsibility; and, consequently, a large spread in salary. The marked dip at the beginning of the "teaching" curve is caused by isolated data; the shallow dip in the "reports" curve is probably a leveling point, but because of averaging scattered points, plots as dip.

Figures 4a and 4b present answers to question 23, "Are you engaged in many daily tasks which could be effectively handled by subordinate personnel?" by employer category and by age. Neither are surprising in the trends which they show although the general level of the curve of Figure 4b is higher than expected.

Figure 5 shows a graphical comparison of the answers to question 13, "Do you feel that you are adequately informed as to your company's management policies and planning for the future?" by employer category. This question permitted investigation of one facet of employer-employee relations. Figure 6 merely shows the answer to question 8a, "Are you satisfied with Civil Engineering as a profession," as a bar graph.

Figure 7, showing answers to question 8c, "Are you satisfied with your own opportunities for advancement," permits some interesting comparisons with Figure 3. Discounting "research," which represents a small number of returns, the type of work categories in which the lowest number of "yes" answers were received are drafting, reports, and specifications. All three of these in Figure 3 show definite leveling points. Teaching, the next lowest, shows a rising curve in Figure 3 while design and plant operation, the next two categories, show leveling points. Estimating and field supervision also show leveling points. Sales and management show high "yes" answers. A general conclusion might be drawn thus: The type of work generally preceding advancement into management has reported more "yes" answers than the other fields.

Figure 8 presents the answers to question 27, "How would you rate the following conditions where you work?" The results are varied and general conclusions are difficult to draw. Comparison with Figures 4a, 5, and 7, while interesting in certain isolated instances, such as local government, Figure 4a, and supervision, Figure 8a, variance in daily tasks, Figure 8b, fails to point conclusively to any specific trend.

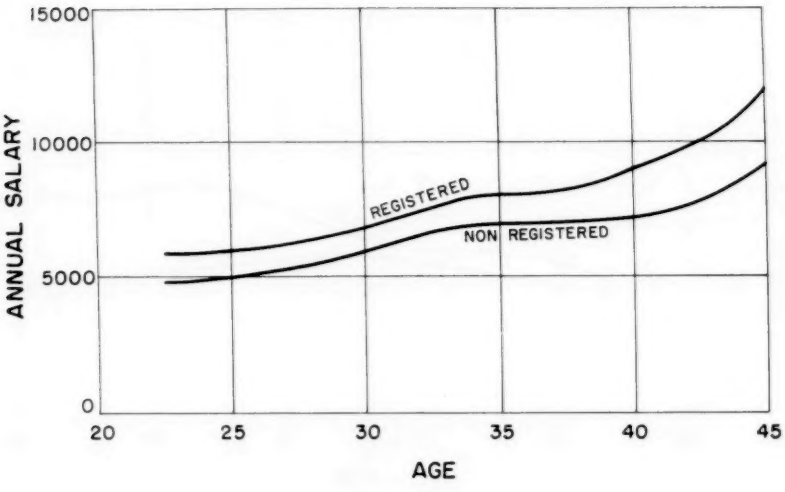
The fact that no particular trend is exhibited throughout the curves and comparisons do not indicate a lack of success in the survey. On the contrary, it indicates that the threat of unionism in the survey area seems to have little ground for a foothold, other than salary, and on that question, it is a moot point whether the survey results indicate anything other than normal conditions.

Respectfully submitted,

Robert E. Vansant
James G. Stinson
William G. Richey
Elroy C. Balke
Alan R. Marsh
Kenneth W. Philo
Ray C. Bergendoff, Chairman

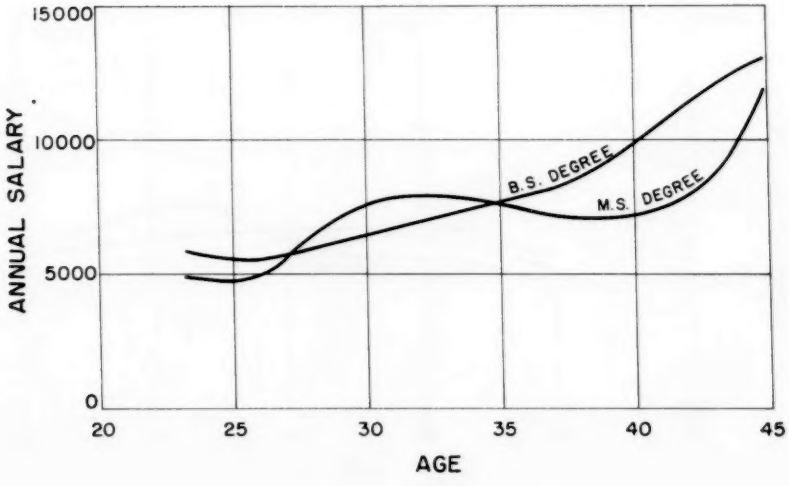
Junior Activities Committee,
Kansas City Section, ASCE

EARNINGS VS. REGISTRATION STATUS



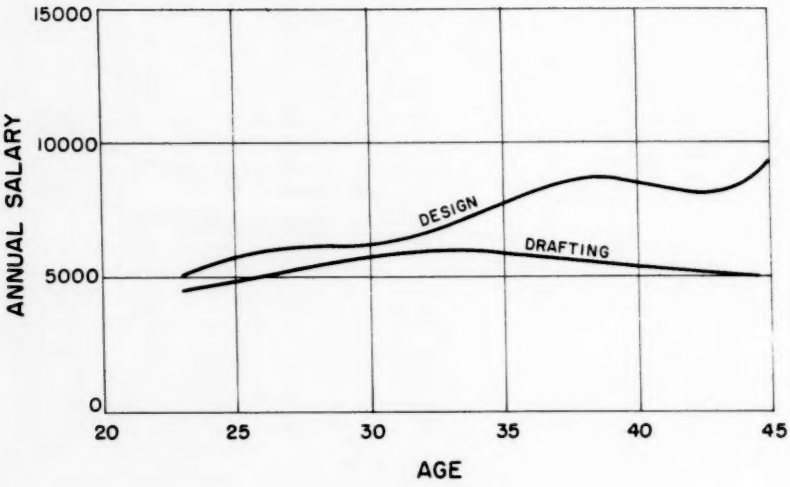
- FIG. 1 -

EARNINGS VS. EDUCATION

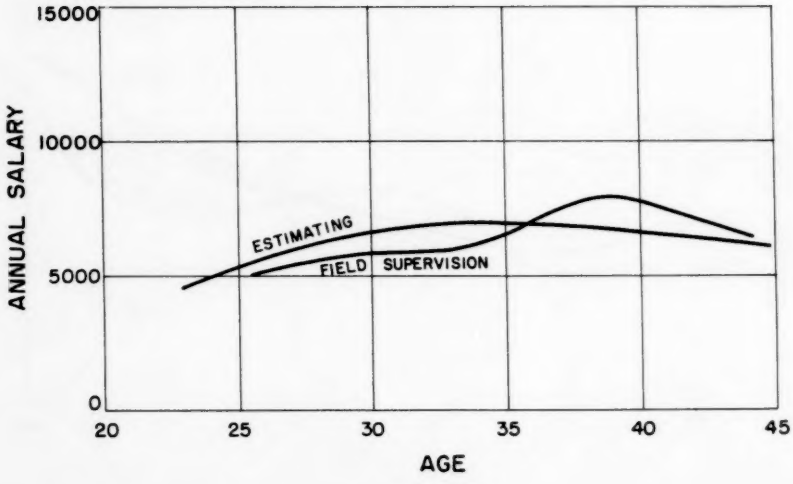


- FIG. 2 -

EARNINGS VS. TYPE OF WORK

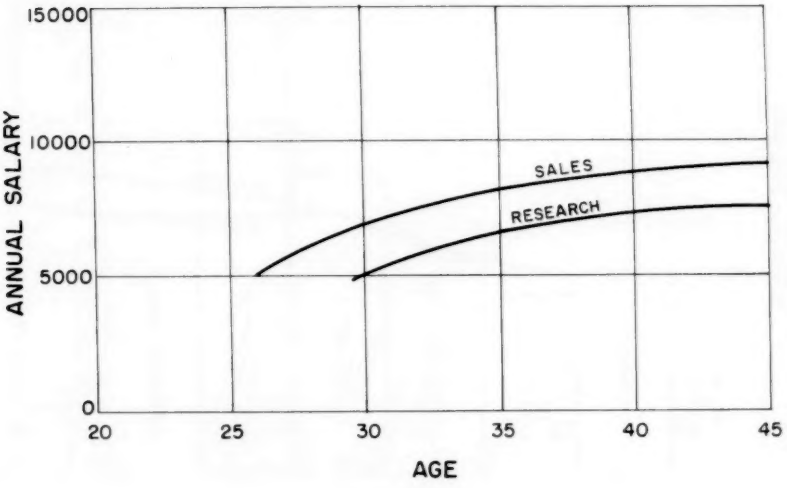


- FIG. 3a -

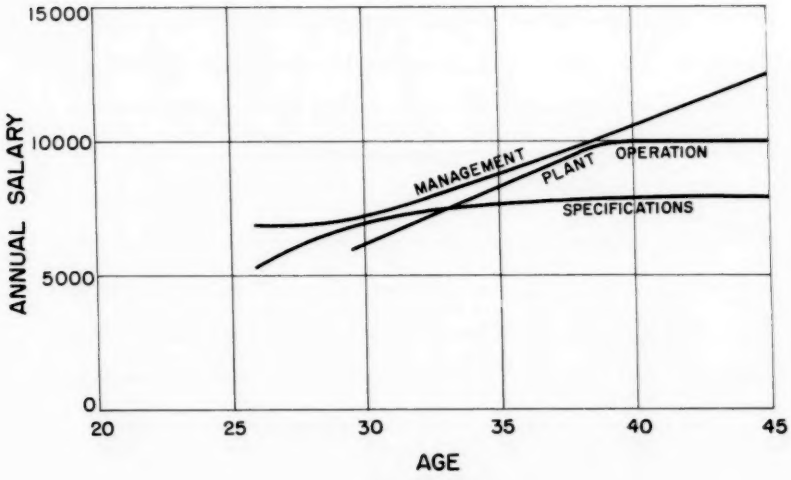


- FIG. 3b -

EARNINGS VS. TYPE OF WORK

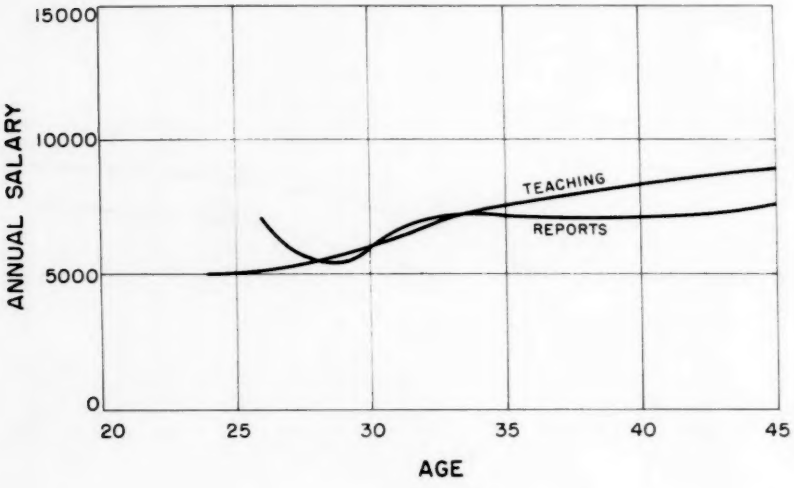


- FIG. 3c -



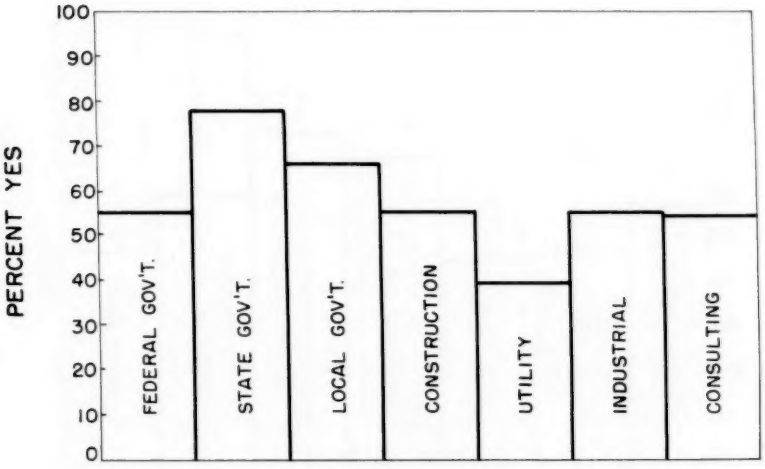
- FIG. 3d -

EARNINGS VS. TYPE OF WORK

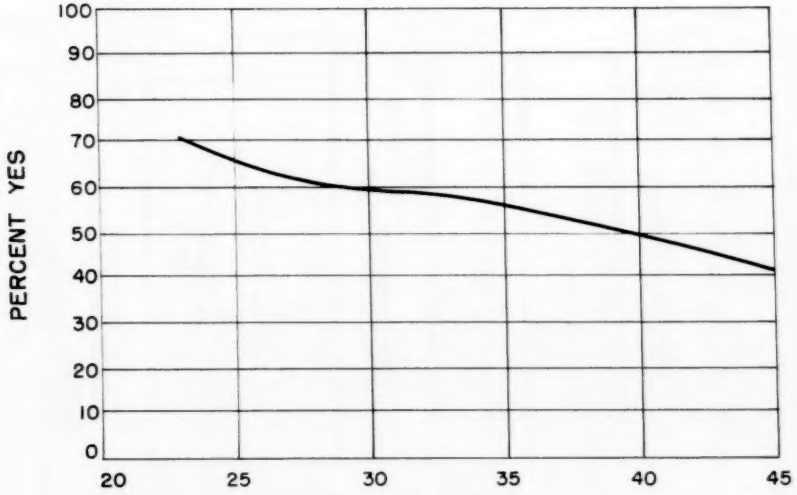


-FIG. 3e-

ARE YOU ENGAGED IN MANY DAILY TASKS WHICH COULD BE EFFECTIVELY HANDLED BY SUBORDINATE PERSONNEL ?

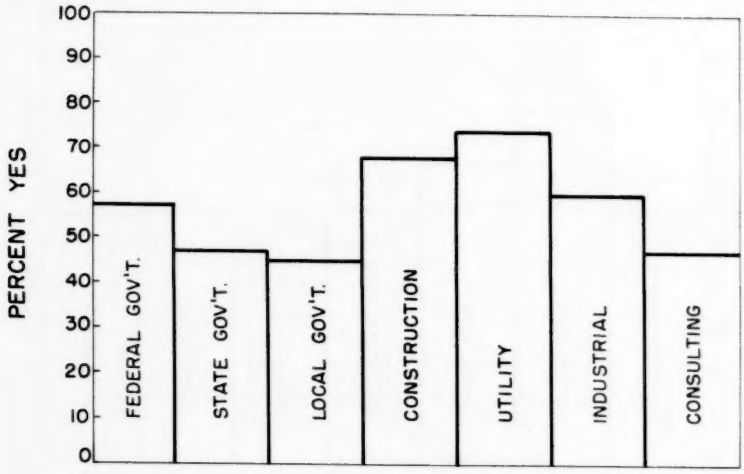


-FIG. 4a-



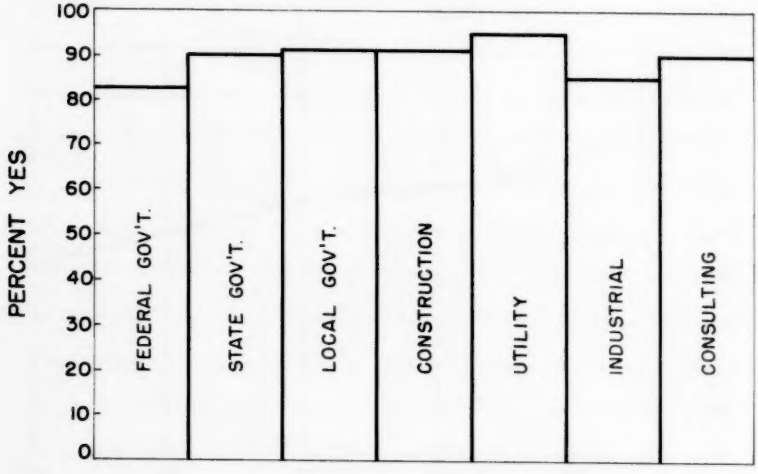
-FIG. 4b-

DO YOU FEEL THAT YOU ARE ADEQUATELY INFORMED AS TO YOUR COMPANY'S MANAGEMENT POLICIES AND PLANNING FOR THE FUTURE ?



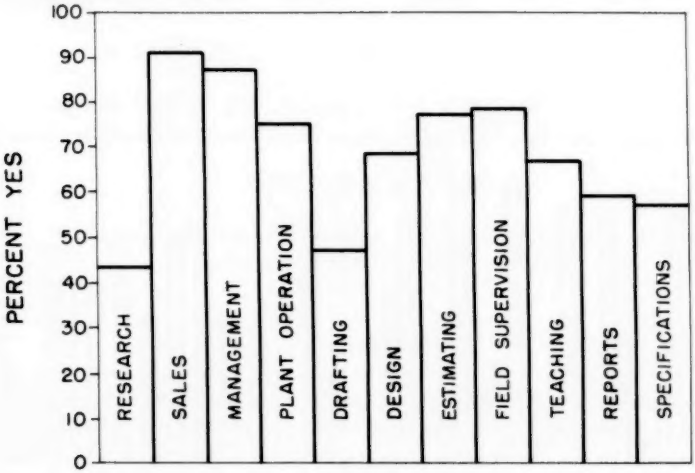
-FIG. 5-

ARE YOU SATISFIED WITH CIVIL ENGINEERING AS A PROFESSION?



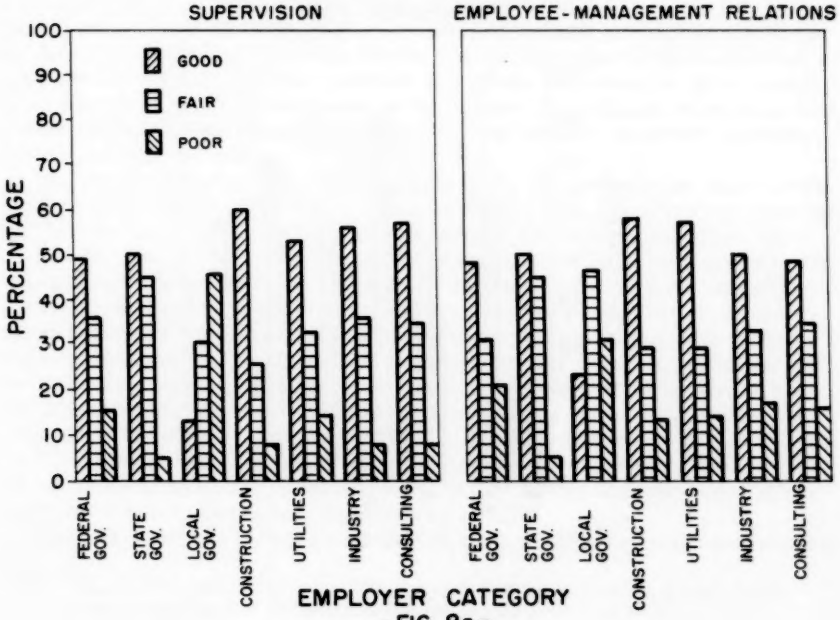
-FIG. 6-

ARE YOU SATISFIED WITH YOUR OWN OPPORTUNITY FOR ADVANCEMENT ?

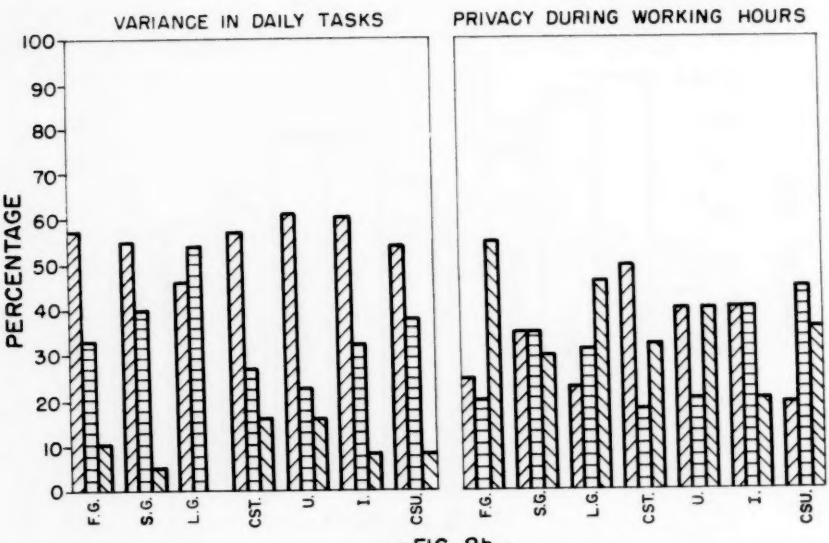


-FIG. 7-

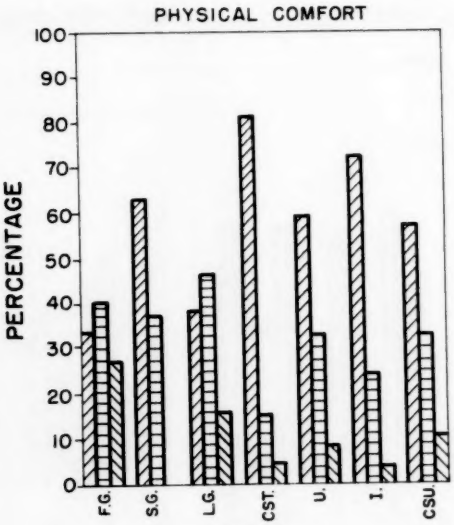
HOW WOULD YOU RATE THESE CONDITIONS WHERE YOU WORK?



-FIG. 8a-


VARIANCE IN DAILY TASKS
PRIVACY DURING WORKING HOURS
PERCENTAGE
100
90
80
70
60
50
40
30
20
10
0
F.G.
S.G.
L.G.
CST.
U.
I.
CSU.

-FIG. 8b-


PHYSICAL COMFORT
PERCENTAGE
100
90
80
70
60
50
40
30
20
10
0
F.G.
S.G.
L.G.
CST.
U.
I.
CSU.

-FIG. 8c-

Journal of the
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ENGINEERS AND UNIONS

Report of a Special Committee of the Junior Member Forum
of the San Francisco Section, ASCE
(Proc. Paper 1487)

INTRODUCTION

The purpose of this report is to discuss the relationship between engineers and unions. The problem of unionization and collective bargaining for engineers arises because of two reasons:

1. Dissatisfaction of engineers with their professional status.
2. Encroachment by labor unions into the field of engineering.

The first is evidenced by the 1953 ASCE poll,(1) in which approximately 25 percent of the 17,000 members responding stated that collective bargaining was or would be advantageous to them. This phase of the problem has received some attention in the past few years and while it perhaps is the more fundamental of the two, the main efforts of this investigation were directed upon the second aspect of the problem, that of encroachment by labor unions. This special attention is the result of the current predicament of some of our membership who find themselves faced with the problem of practically being forced into a labor union.

The past half century has witnessed the birth of a tremendous labor movement in this country. The trades and crafts have been organized into national and international unions which recently merged into one organization, the AFL-CIO. One of the avowed purposes of this organization is to organize the unorganized. Included in the classes of employees scheduled for intensive organizational drives by the trade unions are engineers. Several other recognized collective bargaining units are also engaged in soliciting engineers' membership passively or actively. Those engineers living in California will certainly feel these drives since this State has a past history of strong pro-union sentiment. Furthermore, the success of such drives in this State with its expanding economy might influence the measure of success to be expected in other States. Within the past year, several soils engineering firms in the San Francisco Bay Area have been subjected to strong organizational pressures by Local 3, Operating Engineers AFL-CIO.

The Engineer who is faced with the problem of voluntarily or involuntarily

Note: Discussion open until May 1, 1958. Paper 1487 is part of the copyrighted Journal of the Board of Direction of the American Society of Civil Engineers, Vol. 83, No. BD 2, December, 1957.

joining a collective bargaining unit should consider the following questions:

1. What are the rights of an engineer under Federal and State Labor Laws?
2. Is affiliation with a labor union or other collective bargaining unit incompatible with professional status?
3. What are the courses of action open to an engineer?

Labor Legislation and its Relation to Professional Engineers

What are the rights of the individual under federal and state labor legislation?

According to the precepts upon which our country was founded, one of the fundamental freedoms is the right of the individual to work in his chosen field. With the advent and growth of the labor movement in this country, legislation pertaining to the right of individuals to work has been increasingly influenced by the labor group. It is generally believed that this influence has resulted in a betterment of living standards of the people. Recently the engineer either as an individual or with a group of individuals has felt pressure to be assimilated into collective bargaining groups. To protect himself against organization by a group not of his choosing, it is important that he understand his status under present labor laws.

Federal - Taft-Hartley Act

In 1947, Public Law 101 - 80th Congress, commonly known as the "Taft-Hartley Act" was passed by Congress. With the enactment of this legislation, professional employees obtained the right to act on their own behalf rather than be included in heterogeneous groups for the purpose of collective bargaining. Provisions of the Act are administered by the National Labor Relations Board, herein referred to as the NLRB or the Board.

The following information concerning the Taft-Hartley Act is taken from the 1953 ASCE Memorandum by Carey and Chandler.(2)

"The pertinent clauses of the Taft-Hartley Act are found in two parts. Section 2 (12), which establishes a statutory definition of a professional employee for the purpose at hand, reads as follows:

'(12) The term 'professional employee' means -

(a) any employee engaged in work (i) predominantly intellectual and varied in character as opposed to routine mental, manual, mechanical, or physical work; (ii) involving the consistent exercise of discretion and judgment in its performance; (iii) of such a character that the output produced or the result accomplished cannot be standardized in relation to a given period of time; (iv) requiring knowledge of an advanced type in a field of science or learning customarily acquired by a prolonged course of specialized intellectual instruction and study in an institution of higher learning or a hospital, as distinguished from a general academic education, or from an apprenticeship, or from training in the performance of routine mental, manual, or physical processes; or

(b) any employee, who (i) has completed the courses of specialized

intellectual instruction and study described in clause (iv) of paragraph (a), and (ii) is performing related work under the supervision of a professional person to qualify himself to become a professional employee as defined in paragraph (a).'

Section 9(b) establishes the principles under which professional employees are quaranteed the right to have units of their own if they care to do so. Following is a quotation from that section:

'SEC. 9(b). The board shall decide in each case whether, in order to assure to employees the fullest freedom in exercising the rights guaranteed by this Act, the unit appropriate for the purposes of collective bargaining shall be the employer unit, craft unit, plant unit, or subdivision thereof; PROVIDED, the Board shall not (1) decide that any unit is appropriate for such purposes if such unit includes both professional employees and employees who are not professional employees unless a majority of such professional employees vote for inclusion in such unit;'

The essence of this is that a group of professional employees in any place of employment may decide, by majority vote of their own numbers, whether they want to form a unit of their own for collective-bargaining purposes, to join with some other bargaining group, or to refrain from any action of the sort."

To operate under the Taft-Hartley Act it is necessary for professional people to understand the course of action open to them. Continuing from the ASCE memorandum:(2)

"When pressure is brought upon professionals to align themselves with a non-professional organization they can, if they so desire and are sufficiently determined, avoid such association. To do so requires careful attention to necessary procedures, and, unless those affected are sufficiently concerned to find out what is required for independent action and then follow through, they will become victims of the circumstances. There are apt to be details in different situations that make it impossible to establish any set procedure that will apply fully to all. However, certain general principles apply, throughout.

"The NLRB is prohibited from knowingly approving the appropriateness of any collective bargaining unit including both professional and non-professional employees unless a majority of the professionals affected vote for such inclusion. (See Sec. 9(b) of the Act.) Consequently, the Board ordinarily includes in its election order, in cases where a union admitting to membership non-professional employees is the petitioner language excluding professional employees from the bargaining unit.

"If professional employees wish to form a bargaining unit of their own they may do so by selecting some professional committee or professional organization to represent them as their bargaining agent, irrespective of how small the group of professional employees in any particular company is. Such professional committees may consist only of persons who are themselves employees and belong to the unit, or may be composed in whole or in part of outsiders who have had some experience in negotiations. In any event the choice is up to the professional employees in the units. As has been pointed out, the Act places no limitations upon the size of a bargaining unit. Thus, going to an unlikely extreme, two professional employees if they are the only ones

employed in a particular office or a particular plant, may legally constitute a bargaining unit."

Certification and decertification procedures required by the Act will not be discussed. Since the law applies only to disputes affecting interstate commerce it is necessary to understand what is required to obtain NLRB recognition. Professionals wishing to come under the jurisdiction of the Act must belong to a firm or group of firms meeting one of the following conditions:

1. Have received $50,000 in fees per year out of state.
2. Have received $100,000 in fees per year in the state with firms who do at least $50,000 worth of business out of the state.
3. Have received $100,000 in fees per year for national defense work.

The professional employee is well defined under the Act, i.e. in Section 2(12). However, the recently graduated engineer performing sub-professional work poses a difficult problem. Carey and Chandler in the same ASCE memorandum(2) state:

"If an engineer graduate is doing sub-professional work and working toward attainment of professional status, he is performing work related to engineering and must be under the supervision of a professional person in some degree. In such circumstance, the young engineer graduate doing sub-professional (pre-professional) work clearly falls under the provision of clause (b) of Section 2(12) of the Act as earlier quoted. He is in fact a professional employee under the terms of the law and is entitled to statutory classification as a professional employee. As such, he must be included with or without older men, in considerations under the law leading to a decision to form or not to form a professional collective bargaining group."

State of California Legislation*

State Labor Law makes no special provision for the professional employee; there is no "little Taft-Hartley Act."

In 1947 the Jurisdictional Strike Act was enacted and was held constitutional in 1953. This Act may possibly prove to be of benefit to engineers. Quoting from the report of the Los Angeles Junior Member Forum,(3) "The California Courts have ruled that the Jurisdictional Strike Act applies under the circumstances described below:

> A union has picketed an employer in an effort to unionize his employees, none of whom are members of the picketing union. After the commencement of the organizational picketing, the employees formed an independent union which has been recognized by the employer as the collective bargaining agent of the employees. As long as the newly formed union is clearly not company dominated, any further action on the part of the union which first attempted to organize the employees is illegal under the 'Jurisdictional Strike Act'."

* Much of the information included in this section was obtained from a report by the Junior Member Forum of the Los Angeles Section for the Committee on Employment Conditions, ASCE. The report is listed as reference 3.

A development worthy of mention is the recent action by the California Supreme Court. Quoting again from the report:[3] "---The California Supreme Court, in the case of Garmon vs San Diego Building Trades Council, ruled that the California Courts would apply the Taft-Hartley Act in determining the lawfulness of union or employer activity affecting commerce when the NLRB has refused to take jurisdiction. --- This means that before a firm engaged in business affecting interstate commerce can receive protection from the Taft-Hartley Act through California courts, it must first approach the NLRB and be refused jurisdiction."

In general, the State Labor Laws tend to favor the organized collective bargaining unit. The engineer, at present, as an individual has little protection under the law.

Professionalism

Is affiliation with a labor union or other collective bargaining unit incompatible with professional status?

To answer this question, each individual must understand what actually constitutes professionalism.

Under the Taft-Hartley Act, the term professional employee is defined, i.e., Section 2(12). Some aspects of professionalism, however, are not covered by this definition. It is important, therefore that some of the current thinking on professionalism be included. Many persons have attempted to define the term and a number of references pertaining to this are appended.[4,5,6,7] One such definition, that by the Engineers' Council for Professional Development, is stated below:

"1. It must satisfy an indispensible and beneficial social need;

2. Its work require the exercise of discretion and judgment and not be subject to standardization;

3. It is a type of activity conducted on a high intellectual plane -

   a) Its knowledge and skills are not common possessions of the general public; they are the results of tested research and experience and are acquired through special discipline of education and practice;

   b) Engineering requires a body of distinctive knowledge (science) and art (skill);

4. It must have group consciousness for the promotion of technical knowledge and professional ideals and for rendering social services;

5. It should have legal status and must require well-formulated standards of admission."

ECPD further says of professional practitioners:

"1. They must have a service motive, sharing their advances in knowledge, guarding their professional integrity and ideals, and tendering gratuitous public service in addition to that engaged by clients;

2. They must recognize their obligations to society and to other practitioners by living up to established and accepted codes of conduct;

3. They must assume relations of confidence and accept individuals responsibility;

4. They should be members of professional groups and they should carry their part of the responsibility of advancing professional knowledge, ideals, and practice."(8)

Certain organizations have gone on record as being opposed to collective bargaining for professionals. For example, the Council of the American Institute of Chemical Engineers has prepared a policy statement regarding professional standards for guidance of its members. The council has stated its official position as follows:

"The enhancement of the status of the engineer is best promoted by his reliance upon his personal professional growth and accomplishment, and his status as a professional man is endangered by reliance upon group efforts to act on his behalf in reaching short-range economic objectives. At the same time, a corresponding obligation is laid upon the employer of engineers to give each professional employee his due individual recognition as a member of a profession."(5)

In contrast to this, the ASCE Board of Direction in 1946 formally adopted a policy statement prepared by the Committee on Employment Conditions:

"1. Any group of professional employees, who have a community of interest and who wish to bargain collectively, should be guaranteed the right to form and administer their own bargaining unit and be permitted free choice of their representatives to negotiate with their employer.

2. No professional employee, or group of employees, desiring to undertake collective bargaining with an employer, should be forced to affiliate with, or become members of, any bargaining group which includes non-professional employees, or to submit to representation by such a group or its designated agents.

3. No professional employee should be forced, against his desires, to join any organization as a condition of his employment, or to sacrifice his right to individual personal relations with this employer in matters of employment conditions."(2)

These are but a few of the views expressed on professionalism. They include, however, many of the important aspects. Only through a complete understanding of the meaning of professionalism, can one answer the question posed at the beginning of this section: Is affiliation with a labor union or other collective bargaining unit incompatible with professional status?

Courses of Action - Immediate

What are the courses of action available to an engineer when faced with actual or potential enforced unionization?

The actual has become reality for some of our members. Hence it is important that we have a knowledge of the courses of action open to us under present conditions. Three such courses of action are:

1. Do nothing
2. Seek legal protection
3. Affiliate with or form a collective bargaining group

Do nothing

This may not appear to be a course of action; nevertheless, this being a natural tendency, it is the course that many people have followed and will continue to follow. If nothing is done, more than likely young engineers will be picked off one at a time until they are members of a heterogeneous bargaining unit of one form or another. There is the possibility, if this occurs, for the engineer to resign from the union if and when he reaches well defined professional status.

Seek legal protection

From a discussion of Taft-Hartley, it can be seen that the engineer does have protection under the law. However, as pointed out in the discussion, unless the engineer or group of engineers meet the qualifications stated, the NLRB, administrator of Federal Labor Legislation, is not in a position to intervene.

Some employers have, in the past, through either actual or threatened court action, protected their employees from enforced unionization, particularly in cases affecting interstate commerce.

In general, engineers as individuals, have not received satisfactory protection under State Labor Law.

Affiliate with or form a collective bargaining group

At present, there are a number of existing collective bargaining groups in the local area. Three such groups, with their aims and policies are discussed, namely; Engineers and Scientists of America (ESA), represented locally by the Engineers and Scientists of California (ESC); American Federation of Technical Engineers (AFTE); and International Union of Operating Engineers AFL-CIO (Local No. 3).

Engineers and Scientists of America (ESA)(9) (See Note)

The reported purpose of ESA is to give engineers a powerful voice in Congress and the state legislatures by having a political and legal organization which can speak for engineer employees as a group. ESA contends that local engineer units can bargain on an individual basis, but a national organization is needed for effectiveness. Professional societies are controlled by management and thus cannot speak for engineer employees.

The engineer employee does not want to become part of the non-professional AFL-CIO labor movement. The engineer would be absorbed into these unions of production employees and would be without voice and would have his professional stature lessened. The ESA is a collective bargaining agency which will prevent this.

Organization

The ESA is a national service organization to its autonomous sub-units. The service unit has its headquarters in Washington, D. C. There is a

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Note: Since the writing of this report, ESA has become two organizations, dividing the membership about in half. One half will continue under the name Engineers and Scientists in America. It will continue its policy of organizing only professional groups as defined by Taft-Hartley. The other half is to be called the Engineers and Scientist Guild (ESG), comprising both professionals and technicians. A report on this development appears in the August, 1957 issue of Civil Engineering.

full-time President (Amann), Vice-President (Taft), a labor attorney, a lobbying unit and necessary clerical personnel to publish a bi-monthly newspaper, collect salary data on a national level, help new local units in organizing and to keep track of legislation in Congress and in the state legislatures.

The present strength of the 15 sub-units of ESA is about 60,000 members, about 10 percent of which are Civil Engineers. Approximately 20,000 of these members have been acquired in the last 18 months. ESA is about 3-1/2 years old. Of the total membership about 75 percent are professional employees and the remainder are technicians. Most of the sub-units are purely professional. The local unit of ESA, the Engineers and Scientists of California (ESC) is an exception as it allows technical personnel to belong. There are large ESA units in the railroad industry.

The only requirement for ESA membership of an organized sub-unit is that (1) its members are predominately professional and (2) that the sub-unit be certified by the NLRB as the bargaining unit for its members.

Each sub-unit pays $6.00 per year per member to the ESA. There can be special assessments (e.g., at the national convention held in November 1955, the membership was assessed $1.00 per man for the purpose of organizing new engineer sub-units).

Policies

The ESA adheres at present to the following policies:

1. Direct negotiations for wages, salaries, employment conditions and local affairs are the concern of the individual local units.

2. It backs and lobbies for state registration laws for engineers.

3. The use of the strike is regarded as an absolute last resort so far as the organization is concerned. The strike is again controlled by the local striking unit, (e.g., ESA engineers at Minneapolis Honeywell struck in March 1954).

4. The organization is not opposed to compulsory membership; the choice is up to the local unit. There are some "closed shop" ESA units in which the right to work is based upon compulsory membership in the local unit.

5. The organization is not "now" considering an affiliation with the AFL-CIO. It strives to maintain its professional position so as not to alienate the engineers.

6. With regard to bargaining, the organization has a policy of fighting for "merit" increase systems for engineers. It asks management to establish a fund or "kitty" from which such increases can be paid. AFL-CIO is against merit systems. They bargain for across-the-board type increases.

7. The organization acts as a watchdog on Congress and state legislatures on legislation which effects engineers, (e.g., ESA is against the "Kearns" bill in Congress which would prevent organizations of professional personnel from being classified as labor organizations even though their activities might include dealing with employers concerning conditions of employment, salaries, etc. NSPE supports this bill. ESA contends that this bill would re-establish company dominated unions which were outlawed in the 1930's).

8. The organization publicizes the statement that there is not a shortage of engineers, just a misuse of engineering personnel.

9. It acts as an information center for data on salary, wage and working conditions of engineers throughout the country.

10. It is primarily interested in organizing engineering employees of large firms because of NLRB requirements.

The Engineers and Scientists of California (ESC) is the northern California group of ESA. At present there are two active units in the ESC - (1) Western Association of Engineers, Architects and Surveyors, (2) Employees of the P.G. and E. Company. A third unit "The Bay Area Unit" is being formed. This unit will be composed of employees of a number of firms engaged in soil testing, namely; Woodward, Clyde and Associates, Abbot A. Hanks, Hales Testing Laboratory and Hersey Inspection Bureau.

American Federation of Technical Engineers (AFTE)

The American Federation of Technical Engineers of the AFL-CIO is a union of engineer and sub-professional employees formed in 1918. The purpose of the AFTE is to help employee engineers achieve proper compensation and working conditions. Each local chapter of the AFTE as each local union of the AFL-CIO is autonomous.

The AFTE has had locals in the San Francisco Bay Area for many years. At present there are three such organizations, representing personnel of City of Oakland, City of San Francisco and Mare Island Naval Shipyard, Vallejo.

According to members of the organization, representation by a recognized international union for engineers backed by labor and negotiated through experienced business representatives has fulfilled a need and has apparently resulted in improved economic status.

International Union of Operating Engineers

The Operating Engineers Union AFL-CIO represents most of the equipment operators in the heavy construction industry—power shovel, bulldozer, pile driver operators and the like. During World War II this union extended its influence to the civil engineering field by the organization of surveying crews. Locally, the surveyors were first organized by Local 89 of the Technical Engineers and Architects, AFL; Local 89 was later incorporated into the Operating Engineers as Local 3E.

Within the past year, Local 3 has tried, without success, to sign up the field personnel for several soils engineering firms and testing laboratories in the Bay Area. The drive was intensified when the Union succeeded in placing a job classification "Soil Tester" in the 1955-1957 Master Agreement between the Operating Engineers and the Association of General Contractors. (The legality of this agreement as it affects the involuntary organization of soils engineers has yet to be tested.) Business agents of Local 3 have approached employers and clients in their efforts to organize the soils engineers. However, the advantages, if any, of joining the Operating Engineers Union have not been explained to the individual engineer.

Organization of engineers in the soils field is only the initial goal of the Operating Engineers. As explained by one member of Local 3, their ultimate objective is "Union crews working only on plans with a union bug"--i.e. union membership of all engineers, field and office, in the construction industry. The power which engineering membership would give to the Union is obvious. The benefits which the engineer, a minority member of the Union, would derive are more obscure.

If it is felt by a group of engineers that formation of a collective bargaining unit is the solution to their problem, certain requirements should be met. One of these which is highly advantageous, is recognition by the NLRB in order to come under the provisions of the Taft-Hartley Act. Any group affiliating either with ESA or AFTE would more than likely be a new unit and, if possible, should therefore attempt to satisfy the interstate commerce requirement.

Information concerning the formation of an independent group has been collected and can be obtained from the committee.

In concluding this section, it should be mentioned that it is not the purpose of this report to recommend any of these alternatives but merely to pose them and allow engineers individually and as groups to decide which, if any, of the above methods is a solution to problem at hand.

Course of Action - Remedial

In the preceding section, a number of courses of action were considered. These are apparently short range solutions since it is questionable that they really get to the heart of the problem. The underlying objective of any action in this regard should be the improvement of the stature of the profession. Whether any of these actions do this is questionable. Granted, the formation of a collective bargaining unit composed solely of professionals alleviates to a certain degree the problem of union encroachment. Would this problem arise if we were a unified profession? (By unified profession is meant a fellowship of engineers whose regard for the profession transcends the employer-employee relationship). Probably not, that is, it is highly improbable that the unions would be allowed to secure a foothold.

How can the stature of the profession be improved? This is a very difficult question to answer. In this report will be discussed some of the work which has been done by two professional organizations, The American Society of Civil Engineers and The National Society of Professional Engineers.

American Society of Civil Engineers

The ASCE recognized the problem of heterogeneous unionization of engineers over twenty years ago and has pursued a program which has resulted in some degree of protection for professional employees and the dissemination of pertinent information to ASCE members.

The predecessor of the Committee on Employment Conditions was formed by the ASCE in 1937. Through its efforts, information was compiled relative to the union activities under the Wagner Act which permitted labor unions to absorb engineers into heterogeneous locals.

Early actions by the ASCE:

1. Fostering the formation of professional employee collective bargaining groups.
2. Adoption of a policy statement opposing forced membership in a bargaining unit, particularly one including non-professionals, and supporting the right to form independent units.
3. Enlistment of support of other engineering societies and insistance that the so-called "Professional Employee Provisions" be included in the "Taft-Hartley Act."

More recent activities by ASCE:

1. Campaigns to preserve "statutory protection."
2. Publication of articles.
3. Publication of Memorandum entitled "Engineers, Unionization and the Tax Status of ASCE," October, 1953.(2)
4. Collection of data currently from Local Sections pertaining to cases where labor unions have tried to organize professional employees.

Recently the Sanitary Engineering Division of ASCE has backed the efforts of a group of sanitary engineers working toward improving the stature of the sanitary engineer within the framework of existing professional societies. Culmination of this effort has been incorporation of the American Sanitary Engineering Intersociety Board. The expressed purpose of the Board is to improve the practice, elevate the standards, and advance the cause of sanitary engineering. This is to be accomplished by a certification procedure for those licensed by law to practice engineering and possessing special knowledge and competence in the field of sanitary engineering. Holders of such certificates will constitute the American Academy of Sanitary Engineers.

National Society of Professional Engineers (NSPE)(10)

The National Society of Professional Engineers is an organization of registered engineers and engineers-in-training who plan to be registered upon qualification. It is dedicated as an educational institution to the promotion and the protection of the profession of engineering as a social and an economic influence vital to the affairs of men and our nation. The NSPE is concerned with and works toward educating all pertinent groups (legislatures, educators, industry, etc.) at local, state, and national levels as to the value of the engineering profession, the necessity of recognizing the professional status of the engineer, the importance of maintaining the engineer in a just economic status in the community, and the need for improvement in utilization of the engineer.

The NSPE believe that the future development of engineering as a profession must rest upon a framework supported by three essential elements:

1. The individual professional development by his attitudes, his activities, and his participation in professional and civic affairs;
2. The professional society must provide a vehicle through which he can effectively resolve his problems and provide an organization through which his activities will be effective; and
3. The users of engineering services have the responsibility to provide an atmosphere for the maximum professional development of their engineering personnel.

The NSPE originated in 1934 with 2,500 members; in 1954 the membership stood at 30,000, with 39 affiliated state societies and over 325 local chapters. The Society is concerned with federal legislation governing the employment of engineering personnel. In cooperation with a number of other societies, NSPE was active in having included in the Taft-Hartley Law recognition of the unique conditions under which professional employees work. Recently, the Society has been active in sponsoring an amendment to this law which would provide

greater freedom of association by engineering personnel. The matter of collective bargaining and professional development has been the subject of extensive study by the Society. A policy was adopted indicating that NSPE believes collective bargaining to be incompatible with professionalism because of the inherent regimentation. Recognition is given to the fact that engineers-in-training may voluntarily join a union, when as a step in their practical engineering training they are temporarily employed in non-professional or sub-professional work. When promoted to professional responsibilities then, however, the engineer cannot continue his labor union affiliations without sacrifice of professional status. Engineers forced to join a union against their will should seek to extricate themselves by due process of law.

CONCLUSION

In this report information concerning engineers and unions has been presented. Since there are two aspects to the problem, conclusions relative to each are presented.

The problem of encroachment, being a current reality for some of our membership, has received the major portion of attention in the report. Unfortunately, there is no simple 'panacea' for this problem. An attempt has been made to present immediate courses of action open to engineers. These alternatives, it should be emphasized, are short range and designed only to alleviate the immediate problem.

The entire problem can be resolved, at least in part, if all of the employers of engineers would support the professional status of the employee engineers, if all engineers would band together to resist involuntary unionization and, finally, if all engineers would work together for the improvement of the profession.

Respectfully submitted,

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ECONOMIC ADVANCEMENT OBJECTIVES

Final Report of the Task Committee on Study of Economic Advancement Objectives of the Board of Direction
(Proc. Paper 1490)

I. PREFACE

Many members of the American Society of Civil Engineers have felt that while the Society has done an outstanding job of ministering to the technical competence of the members, it has not devoted sufficient attention to their material welfare. In recognition of this feeling, the Board of Direction, in October 1955, voted to establish the Task Committee on Study of Economic Advancement Objectives and directed it to examine what the Society might do to improve the economic status of its members. A copy of the resolution of the Board of Direction establishing the Committee is shown in Appendix "A." The Committee has spent two years on this study during the course of which it has held meetings as follows:

Dallas, Texas	-	February 15, 1956
New York, N. Y.	-	July 11, 12, 1956
New Orleans, La.	-	October 29, 30, 1956
New York, N. Y.	-	January 4, 5, 1957
Cincinnati, Ohio	-	August 9, 1957

The Society's Constitution defines its objective in these words:

"The objective of the Society shall be the advancement of the science and profession of engineering."

This is commonly interpreted as meaning that the Society's major function is professional and that its greatest effort should be directed toward developing, refining, and disseminating engineering knowledge.

We have no quarrel with this interpretation. It must be recognized, however, that the higher levels of professional achievement are not often attained by men whose minds are oppressed by economic burdens. Also, that economic welfare is commonly assumed to be a part of professional advancement. For this reason, and because as a matter of simple justice the engineer's

Note: Discussion open until May 1, 1958. Paper 1490 is part of the copyrighted Journal of the Board of Direction of the American Society of Civil Engineers, Vol. 83, No. BD 2, December, 1957.

compensation should be in reasonable proportion to the value of his services, the Society should not neglect the economic welfare of its members.

In accord with its instruction, the Committee has endeavored to approach its task in a positive frame of mind, endeavoring to explore all possible avenues to economic advancement, within the limits of its capabilities. We are mindful, nevertheless, that the major function of the Society is professional rather than economic, and we caution that this not be lost sight of in reading this report. In the long run, the economic advancement of the profession will depend on the creation of a surrounding climate favorable to economic growth rather than on direct efforts to improve engineers' compensation. This is our long-range objective.

Upon recommendation of the Board of Direction, the Committee cooperated closely with the Task Committee on Professional Education, Adolph J. Ackerman, Chairman. Our Chairman, Lloyd D. Knapp, attended three meetings of Mr. Ackerman's Committee.

This latter Committee, upon authorization by the Board of Direction, engaged the Opinion Research Corporation of Princeton, New Jersey, to make a survey of member opinion of various Society activities. A number of questions bearing directly upon the work and recommendations of our Committee were included. A tabulation of the results pertinent to our work is presented in Appendix "B." A complete report of the survey will be made to the Board by the Task Committee on Professional Education.

II. ADVICE OF COUNSEL ON TAX STATUS

Consideration has been given to possible advantages that might accrue if the Society were to be included under the Internal Revenue Bureau's classification 501(c)6 instead of maintaining its present classification as a 501(c)3 organization.

As basic information the following definitions are quoted from the Internal Revenue Code of 1954, as it relates to tax-exempt organizations;

"501(c) 3

"Corporations, and any community chest, fund, or foundation organized and operated exclusively for religious, charitable, scientific, testing for public safety, literary, or educational purposes, or for the prevention of cruelty to children or animals, no part of the net earnings of which inures to the benefit of any private shareholder or individual, no substantial part of the activities of which is carrying on propaganda, or otherwise attempting, to influence legislation, and which does not participate in, or intervene in (including the publishing or distributing of statements), any political campaign on behalf of any candidate for public office."

"501(c) 6

"Business leagues, chambers of commerce, real-estate boards, or boards of trade, not organized for profit and no part of the net earnings of which inures to the benefit of any private shareholder or individual."

In its original deliberations the Committee sought aid of the Society's legal counsel for opinions on a number of questions relating to the ability of the Society to engage in certain activities of a positive nature which might be proposed by the Committee. See Appendices "C" and "D." Of these legal

opinions rendered, two are considered of particular significance in relation to the work of the Committee, and represent a considerable departure from the understanding prevailing within the Society generally for many years. These are as follows:

A. Regarding Activity on Fee and Salary Scales

Counsel was queried as to what position the Society might take with regard to recommending minimum salaries or fee schedules. It is to be noted that our attorney concluded his extensive findings with the following:

> "My conclusion, therefore, is that the Society and probably its district or regional councils and local sections can recommend minimum salary scales or fee schedules without jeopardizing its present tax status."

It is emphasized that the foregoing applies only to the recommendation of salary or fee schedules, and does not imply the permissibility of attempts to enforce them.

B. Regarding Legislative Activity

With respect to legislative activity on the part of the Society, it is further to be noted that the attorney presented his conclusions as follows:

> "I conclude, therefore, that the Society, even under its present classification, could engage in attempts to influence legislation if the legislation were incident to, or closely connected with, the purposes of the Society, if the sum total of the activities was not substantial. I find nothing in the cases to support the view that the Society may espouse or oppose, as the case may be, any legislation merely because it involves engineering problems. I conclude that the Society, in order to preserve its present status must limit such activities to a point where it can prove on a time or expense basis, that they were not substantial."

It is the opinion of this Committee that the information in "A" and "B" above should be passed on to the membership of the Society. In providing such information, the membership should be cautioned that it is not intended to provide carte blanche authority and that advice should be sought from the headquarters office by local groups before undertaking any activities of the sort indicated.

C. Effect of Business League Status

The Committee also requested counsel and the Society staff to report upon the effect to the Society in the event that its actions might cause the Internal Revenue Service to change the status of the Society from a purely scientific and educational organization into a so-called business-league status such as that in which the American Medical Association, the American Institute of Architects, and EJC are presently classified.

It is the considered opinion of the Committee that the Society should, for the present, govern its activities in such a manner as to maintain its present tax status for the following reasons:

1. The Founder Societies with which we seek to establish a unity organization are classified as scientific and educational organizations. Should our present tax status be changed, it is foreseen that an additional obstacle to achieving unity will result.

2. The activities that this Committee recommends for the purpose of achieving immediate and long-range economic advancement objectives can be engaged in without jeopardizing our present tax status.

3. The Society and its members would lose certain tax advantages they now enjoy. Gifts and bequests to the Society would no longer be tax exempt. Property of the Society and property of the United Engineering Trustees rented to the Society would be subject to a real estate tax. Although these advantages may not be of overriding importance, they are, nontheless, factors to be considered.

4. It would appear that the Society would lose some degree of professional stature should its classification be changed to that of a business league.

III. COMMITTEE RECOMMENDATIONS FOR PROPOSED SOCIETY ACTION

In considering the areas of activities in which the Society should engage on behalf of the economic and professional welfare of its membership, the Committee has divided its recommendations and observations into two categories: activities to achieve immediate objectives and activities to achieve long range objectives.

A. Activities to Achieve Immediate Objectives

Under the immediate category the following projects should be undertaken promptly, and this Committee so recommends:

1. Representation in Washington, D. C.

In order to maintain and improve professional standards in Government service, to defend the rights of professional employees, to advance the interests of the engineering profession, and to serve the general welfare, we have previously recommended the immediate establishment of strong representation for the Society in Washington, under the direction of the Headquarters staff. We reiterate this position. (Note: The Committee has been informed that steps have been taken toward establishing appropriate representation and that it is anticipated, as of the date of this report, that arrangements will be completed in the near future.)

The Opinion Research Survey indicates that 65 percent of our members favor the establishing of representation for the Society in Washington, D. C.

At the same time we urge that the Society bring the strongest pressure to bear on EJC to establish an adequate Washington office to represent the engineering profession generally with suitable financial support.

2. Relay Advice of Counsel to Local Sections

It is recommended that the membership be informed of the present legal opinion as to the extent to which it may engage in legislative activities. The local sections should be advised that the Society's staff is available for such assistance as may be needed in these matters.

This subject should be presented directly to local sections, be carried on agenda for local section conferences and meetings of district councils, and be published in Civil Engineering. (Note: As the result of recommendations in the Committee's Interim Report, dated January 5, 1957, publicity has been carried in Civil Engineering and local sections have been informed separately.)

3. Necessary Increases in Staff

Item (2) above, will undoubtedly result in many demands upon the Society by local section for assistance, which makes it imperative that the staff be increased at an early date with additional highly qualified personnel.

4. Engineering Salaries

We recommend that the Society re-establish the practice of providing, on request, advice and assistance to employers or groups of employees seeking to develop and establish equitable classification and salary schedules. We envision that this service will require assignment of staff members, use of salary information developed or to be developed by the Committee on Salaries, and the establishment of local section salary committees.

Opinion Research Corp. in its survey, provided the following interesting information:

"Should the Society devote more time and effort to improving fees, salaries, and working conditions?"

	Juniors	Associate Members	Members
Yes	70%	71%	55%
No	18%	18%	35%
No opinion	12%	11%	10%

5. Fee Curves

With the belief that the present fee curves (Manual No. 29) are inadequate and are not readily applicable to some work, it is recommended that the Committee on Professional Practice develop and recommend current fee curves.

B. Activities to Achieve Long Range Objectives

In the long-range category, the following matters should receive immediate and continuing attention by the Society, usually by the existing standing committees charged with the respective responsibilities.

1. Unity of the Engineering Profession

The Committee is strongly persuaded that the greatest hope in achieving economic-advancement objectives will be realized only when there is a unity organization to represent the entire engineering profession. Accordingly, it recommends that the Society continue to achieve effective unity of the engineering profession.

The results of various surveys made available to the Committee generally confirm popular opinion concerning local apathy and ineffectiveness in the handling of professional problems. This appears to stem in part from lack of unity at the local level, in part from lack of local leadership, and in part from the general deterioration of local responsibility that has characterized the American scene in recent years.

This Committee believes that if we are to have a vigorous, united engineering profession, we must first have vigorous, united engineering societies, and before that, leadership, unity, and vitality in the local groups. As a beginning, we urge that the Society, acting through its Officers and Directors individually and collectively, through its Committee on Local Sections, through Local

Section and Regional Council Conferences, and otherwise, drive home to local groups that unity of the profession is essential. That unity begins at home; and that while the parent Society may lead, in the end, large responsibility for putting a firm foundation under professional unity lies with the local people. When engineering groups within an area, a state or states are faced with a common problem, it is incumbent upon them to unify effectively to approach that problem in common accord and in an appropriate manner.

2. Increased Emphasis on Registration

We believe that economic and professional advancement of engineers can be furthered by greater emphasis on registration, whether in public or in private practice. The Committee on Registration should be strongly supported in increasing and extending its activities in this direction at all levels.

3. More Effective Public Relations, National and Local

From available surveys it is evident that there is a substantial demand for effective public relations. Such a program must be carried out simultaneously at national and local levels. It involves an increase in the public relations staff to place added emphasis on current efforts to school, direct and assist local groups as well as conduct the national program.

The Opinion Research Survey indicates that 69 percent of our membership favor increasing the Society staff to step up local and public relations.

4. Junior Members

Many problems of Junior Members are largely common to the membership as a whole and have been so treated. Concern with the title and tenure of Junior Members is a matter of Society structure, and properly under the cognizance of the Committees on Junior Members and Membership Classification.

5. Better Training

The general shortage of engineers has been well publicized. This Committee believes that the quality of civil engineers should also be emphasized. Opinion Research reports as follows on opinions as to the adequacy of the civil engineers' college training:

Have Proper Training	-47%
Serious Shortcomings in Training	-36%
No opinion	-17%

It is disturbing to note that 36 percent of our members feel that civil engineers have serious shortcomings in training.

Adequate college training of civil engineers means adequate faculties of high quality. These cannot be constructed to order, overnight, but must be built slowly, on a foundation of able young men. This Committee is gravely concerned over the difference between salaries paid to teaching staffs by the technical colleges and those offered by industry. Salaries must be competitive if teaching staffs are to be expanded and strengthened. To accomplish this end, the Society should seek every means consistent with its policies to secure adequate salaries for engineering educators.

The Society's salary surveys should be used for recommending minimum salaries for engineering faculties. Outstanding young men should be encouraged to enter the teaching field. Practicing engineers and industry

should be urged to assist in the education and training of teachers. Graduate engineers should be encouraged, where possible, to secure advance degrees and obtain additional training through enrollment in night classes and by other means.

6. Professional School

It is also recommended that the Society through its Committee on Engineering Education promote the establishment and recognition of engineering schools as professional schools. Such a status, which is now enjoyed by schools of medicine and law, would facilitate the establishment of salary scales adequate to attract competent personnel, the adoption of admission standards to insure high scholastic standards, and the development of curricula to meet ECPD objectives.

7. Code of Ethics

We recommend that the proper Committee be directed to study the appropriate sections of the Constitution and Bylaws for necessary revisions relating to disciplinary action for violations of the Code of Ethics. We also recommend that for information and future guidance, disciplinary actions taken by the Board of Direction for violations of the Code of Ethics be appropriately publicized, citing the type of violation, case history, and other pertinent information but without mentioning the names of those involved.

8. Professional Relations in Large Organizations

The number of large engineering offices, both public and private, has been increasing in modern time. The maintenance of a professional atmosphere in such offices may present unique challenges. The Committee on Employment Conditions has been concerned with such matters and related problems where they exist. It is recommended that they continue their studies with the view toward improving professional employment conditions where such improvement is needed. Employer members of the Society should be reminded that they bear the important responsibility of maintaining professional relations in their own organizations.

9. Labor Relations

The Committee gave consideration to problems in the field of labor relations with the object of determining whether the Society can, and, if so, should do more to assist its members who become concerned with collective bargaining.

Research conducted in 1957 by the Opinion Research Corporation indicated that 68 percent of our membership believe that the Society should not support collective bargaining, 19 percent believe that it should, and 13 percent expressed no opinion. In answer to a question as to whether collective bargaining is appropriate for engineers, 84 percent said it is not, 12 percent considered it to be proper, and four percent had no opinion. Although the two responses are not entirely consistent, both show that a substantial majority of the membership is opposed. These data are in general accord with results of the questionnaire submitted to the membership in 1953.

In spite of the foregoing, the Committee felt that it should explore the possibilities for positive action by the Society. This was deemed of particular importance in view of what appears to be a very general misunderstanding among our members about the possibilities.

ASCE has done much constructive work. It took the lead in having the professional-employee provisions included in the Taft-Hartley Act. It developed a program under which local sections properly could initiate the creation of collective bargaining groups of professional employees. It has appeared as "friend of the court" in labor action that threatened the interests of members. It has given constructive advice in situations where guidance was sought. It has published literature pertinent to problems of collective bargaining.

It must be understood that the Society cannot give any support to a collective-bargaining organization. That fact has no relation to tax status, but is prohibited by the labor laws. A collective-bargaining unit must be composed solely of employees. Thus ASCE, with its membership composed of both employees and employers, cannot act as a collective-bargaining agent. Neither can it give financial aid nor any other direct help to a bargaining unit.

The Committee explored the possibility of creating some sort of subsidiary organization that would be composed only of Society members who are employees, with the idea that such an organization would have latitude in rendering direct assistance. Such a program has not been found feasible.

The Committee concludes that the Society cannot engage in matters of labor relations in areas not already included in its program. It recommends that the Society continue its leadership in those areas where it can operate, and that the headquarters staff continue to give advice and guidance in appropriate circumstances.

10. Definition of Functions of Technicians, Subprofessional, Preprofessional and Professional Engineers

Some of the problems of professionalism, upgrading and the like, indicate the need for suitable definitions of the terms technician, subprofessional, preprofessional, and professional. It is recommended that the Committee on Membership Qualifications be assigned the task of developing such definitions, conferring with other interested committees.

IV. CONCLUSIONS

The recommendations made herein will not, in the opinion of the Society's legal counsel, affect the tax status of the Society. Consequently, there can be no effect upon United Engineering Trustees or upon Engineers Joint Council. As a matter of fact, E.J.C. is at the moment classified by the Bureau of Internal Revenue in Section 501(c)(6) "business leagues, etc."

If at some future time the Society should be placed in the "business league status" it appears that real estate taxes would probably be levied on its property and on any property of U.E.T. leased to the Society.

Gifts and bequests to the Society might, under some circumstances, be subject to gift or estate taxes. However, it appears pointless to pursue this line of investigation further at this time.

The Committee wishes to express its appreciation for the assistance of Assistant Secretary E. L. Chandler, who attended all of its meetings and acted as its secretary.

The Committee also wishes to thank Mason G. Lockwood, who was a most active member of the Committee until his election as President of the Society, for his continued interest and guidance in its work.

Many other officers of the Society particularly Executive Secretary

William H. Wisely, Vice President Glenn W. Holcomb, and Director Don M. Corbett attended many of our meetings and greatly aided the Committee with their advice and suggestions.

Mention already has been made of the Intermim Report, dated January 5, 1957, which was submitted to the Board of Direction. The basic recommendations in this Final Report are the same as those submitted in the Interim Report. The original ideas have been expanded somewhat and the language has been clarified. Also, certain information obtained from the Opinion Research survey has been included.

The Committee feels that, with the submission of this final report, it has completed its assigned Task and respectfully recommends that it be discharged.

Respectfully submitted,

Oscar S. Bray
Ralph E. Fadum
Edmund Friedman
Carl G. Paulsen
Roy T. Sessums
Charles W. Yoder
Lawrence A. Elsener, Board Contact Member

Lloyd D. Knapp, Chairman
Task Committee on Study of Economic Advancement Objectives

APPENDIX A

Action of ASCE Board of Direction

which established the

Task Committee on Study of Economic Advancement Objectives

* * * *

At its meeting in October 1955, the Board of Direction voted:

"That a task committee be appointed to make a complete new study and investigation as to what the Society can do to improve the economic status of its members, such study and investigation to be a positive approach to the problem with the object of determining what the Society might be able to do rather than what it cannot do, such study to determine the effect of any proposed recommendations on the tax status of the Society and its relations with EJC and UET, and that the headquarters staff and the Society's Legal Counsel be instructed to assist the task committee."

APPENDIX B

Partial Results of Survey of Members of ASCE by Opinion Research Corporation

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Should the Society devote more time and effort to improving fees, salaries, and working conditions?

	Juniors	Associates	Members
Yes	70%	71%	55%
No	18%	18%	35%
No opinion	12%	11%	10%

Would more direct efforts to improve members' economic welfare weaken the Society's professional status?

No	63%
Yes	28%
No opinion	9%

Should the Society support formation of local professional groups for collective bargaining?

Should not	68%
Should	19%
No opinion	13%

Collective bargaining for engineers

All right	12%
Should stay out	84%
No opinion	4%

Will growth of collective bargaining undermine professional standing of engineers as a whole?

Yes - seriously	72%
Little difference	21%
No opinion	7%

Support for increased public relations activity

Favor establishing representation for the Society in Washington, D. C.	65%
Favor increasing Society staff to step up local and national public relations.	69%

Adequacy of the civil engineers' college training

Have proper training	47%
Serious shortcomings in training	36%
No opinion	17%

What engineering educators say ASCE can do for civil engineering education

3. Support better pay for teachers, alert industry to college financial needs.

5. Continue and expand public relations efforts

Total of 7 items.

APPENDIX C

Davidson, Dawson & Clark

Counsellors at Law
63 Wall Street
New York 5, N. Y.

COPY September 28, 1956

Mr. E. L. Chandler, Assistant Secretary
American Society of Civil Engineers
33 West 39th Street
New York 18, New York

Dear Mr. Chandler:

In your letter of July 20, 1956, you enclosed a copy of the minutes of the meeting of the Task Committee on Scope of Professional Activity held on July 11-12, 1956, which sets forth a number of questions on which the Task Committee wished to have my opinion before the annual meeting in October. I shall take up these questions in the order in which they appear in the minutes.

1. Change in classification. I was asked to set forth any undesirable consequences which might follow the loss of your Society's present tax status and being classified as a business league or trade association. I am setting forth below the difference in the tax effects.

The latest ruling of the Internal Revenue Service covering the status of the Society was dated July 27, 1948, and classified the Society as an organization exempt under Section 101(6) of the Internal Revenue Code of 1939 as a corporation organized and operated exclusively for educational and scientific purposes. The ruling stated that the Society would not be required to file income tax returns except the annual information returns on Form 990 and that it need not pay the employment taxes imposed either by the Code or the Social Security Act on remuneration for services performed by employees. It further stated that contributions made to the Society would be deductible as charitable contributions both by individuals and corporations, that gifts of property would be deductible for gift tax purposes, and that bequests, legacies, devises or transfers would be deductible for estate tax purposes. The section under which the Society was then classified, Section 101(6) of the Internal Revenue Code of 1939, is substantially identical with the present Section 501(c) (3) of the Internal Revenue Code of 1954. The ruling also stated that any changes in the character, purposes or methods of operation of the organization should be reported immediately to the Collector of Internal Revenue of your district in order that their effect upon your tax exempt status might be determined.

This ruling was a result of a protest against the action of the Internal Revenue Service in classifying the Society, in a Bureau ruling dated January 29, 1948, under Section 101(7) of the Internal Revenue Code of 1939. That section, which is identical with Section 501(c) (6) of the Internal Revenue Code of 1954, covers the following organizations:

'Business leagues, chambers of commerce, real-estate boards, or boards

of trade, not organized for profit and no part of the net earnings of which inures to the benefit of any private shareholder or individual."

The ruling of January 29, 1948, stated that no income tax returns other than the information return on Form 990 need be filed. It further stated that contributions did not constitute allowable deductions either to individuals or corporations, that gifts of property were not deductible for gift tax purposes, and that bequests, legacies, devises or transfers were not deductible for estate tax purposes. In a separate ruling the Internal Revenue Service held that your Society was subject to Federal employment taxes, but both of these rulings were revoked as a result of the ruling of July 27, 1948.

The differences in tax consequences may be easily summarized. Neither type of organization is required to pay income taxes or to file income tax returns other than the information return, Form 990. Educational and scientific organizations of your type were not required to pay Federal employment taxes unless the employees consented, in which case the Society could volunteer such payments. It is my understanding that such consent and payment have been made, and so there is no difference so far as these taxes are concerned.

The principal difference lies in the deductibility or nondeductibility of contributions for the purposes of the income tax, and gifts, bequests and devises for the purposes of the gift and estate taxes. I believe your office was to estimate the probable annual cost of the loss of such deductions.

So far as the income tax deductions are concerned, it seems to me that a change in classification might not be too serious. It is true that individual members would not be allowed to deduct their dues or other gifts as contributions, but in my opinion the annual dues would be deductible, if the Society were classified as a trade association, as an ordinary and necessary business expense if the individual was engaged in the practice of the engineering profession or engaged in a business in which dues paid to an engineering society could be demonstrated to be ordinary and necessary expenses. It might be more difficult for a corporation to deduct gifts, but a plausible argument for the deductibility of such gifts could be made by those corporations which serve the engineering profession.

There would be a real difference in the deductibility of gifts for gift tax purposes and of bequests and devises for estate tax purposes. How important this would be to the Society can probably be estimated from its past experience. The imponderable here is the question of whether such gifts, bequests or devises will be withheld in the future if the donors or testators know that they are not deductible. I see no way of determining this factor although it can be reasonably assumed that a donor or testator would think twice before making a substantial gift to the Society if he knew that it was not deductible.

Among the reasons advanced at the July meeting of the Task Committee for making a change in the classification of the Society was to permit activities permissible for organizations of a "business league" type, but not permissible for those classified as educational and scientific. There was discussion on the Society's taking an active part in labor disputes, legislation, and efforts to maintain higher salaries for engineer employees. It is my opinion that it would be dangerous to engage in such activities under the present classification. I am unfamiliar with the nature of the activities

contemplated under the heading of "labor disputes" and shall confine my remarks to legislation and salary or fee activities.

You will recall that one of the grounds on which the Internal Revenue Service sought to justify the 1948 change in classification was that the Society devoted a substantial part of its activities to "carrying on propaganda, or otherwise attempting, to influence legislation." We were able to show that the appearances before legislators or legislative committees were infrequent and generally by request for the reason that the proposed legislation involved engineering questions. We were also able to show that less than one per cent of the Society's annual budget was devoted to such activities.

There are a number of rulings and court decisions which have permitted fairly substantial legislative activities, without denying exemption as a charitable, religious, scientific or educational organization. Unfortunately, these rulings and decisions all related to special facts and have not produced a good general, practical working rule. The courts, however, seem to have recognized a distinction between legislative activities of a general character and those engaged in as a necessary incident to the carrying out of the purely charitable, educational or religious purposes of the organization. The latter seem to be permissible if they do not constitute a substantial part of the organization's activities. I have reviewed such decisions as there are on the question and it appears that even the most liberal of the decisions still require such activities to be a small part of the general activities of the organization as a whole. I conclude, therefore, that the Society, even under its present classification, could engage in attempts to influence legislation if the legislation were incident to, or closely connected with, the purposes of the Society, if the sum total of the activities was not substantial." I find nothing in the cases to support the view that the Society may espouse or oppose, as the case may be, any legislation merely because it involves engineering problems. I conclude that the Society, in order to preserve its present status, must limit such activities to a point where it can prove, on a time or expense basis, that they were not "substantial."

2. Minimum salary and fee schedules. On reviewing my notes of the Washington conferences, I find that one of the points raised by the conferees was that the Society had prepared tables of salaries for engineer employees in different grades, and schedules of fees for engineering services, and this was taken to mean that the Society was organized and operated, at least to some extent, for the economic betterment of the members. We were able to show these schedules were merely recommendations and suggestions for appropriate practice and that the Society not only did not attempt to enforce them but had no means of enforcing them. If the Society were to take a stronger position on these questions and acquire the means of enforcing such schedules, it would probably find itself in the position of the American Medical Association whose activities along these lines were a factor in denying its claim to be organized exclusively for scientific or educational purposes. In a case decided in the Supreme Court of Illinois it appears that the Medical Association operated a bureau known as a "Bureau of Medical Economics." It printed and distributed to the members tracts such as "Collecting Medical Fees" and "Organized Payments For Medical Services," and it maintained records of collection agencies which could provide physicians with data as to

the financial status of patients. Furthermore it included in its "Principles of Medical Ethics" an article dealing with compensation which declared it unprofessional for a physician to dispose of his services under conditions which interfere with reasonable competition among physicians and further provided that medical services should be paid for by the patient in accordance with his income status. It appeared that the Association had power to enforce its rules both through its Principles of Medical Ethics and also by control over the acceptance of its members on hospital staffs. The court concluded that these activities promoted the same objects as rules of trade associations, labor unions, and the like, and were proof that the Association was not organized and operated exclusively for scientific and educational purposes.

My conclusion, therefore, is that the Society and probably its district or regional councils and local sections can recommend minimum salary scales or fee schedules without jeopardizing its present tax status. If, however, an attempt is made to enforce such schedules, as perhaps through the adoption of an additional paragraph in the Code of Ethics, it would be difficult, if not impossible, to convince the Internal Revenue Service that these activities were only incidental to the Society's educational and scientific purposes. I believe that anything which tends to show an active interest in the economic improvement of the members would be an invitation for a change in classification as showing the adoption by the Society of one of the usual objectives of trade associations.

Aside from the question of tax exemption, it is my opinion that the formulation and publication of minimum wage and fee schedules does not violate any Federal law. Such schedules are common not only in trade associations but also in professional organizations. For example, Canon 12 of the Canons of Professional Ethics of the American Bar Association, relating to fees, states in part as follows:

> "In determining the customary charges of the Bar for similar services, it is proper for a lawyer to consider a schedule of minimum fees adopted by a Bar Association, but no lawyer should permit himself to be controlled thereby or to follow it as his sole guide in determining the amount of his fee."

My research has discovered no cases where the fixing of minimum fees or wages has been attacked as a restraint of trade. So far as the Sherman Anti-Trust law is concerned it appears that there is still no definitive answer to the question of whether an association of professional men is engaged in "trade" within the meaning of the Sherman Act. At least one Court of Appeals has held that a medical association is so engaged but the Supreme Court has not yet passed on this question to my knowledge.

On the question of whether a change in your Society's tax classification would have any effect on the status of the other constituent societies of EJC, it is my opinion that it would not. As you know, EJC has itself been classified as exempt under Section 501(c) (6) as a business league or trade association. I have given my opinion to EJC that its classification should not affect the constituent members unless the activities of some constituent member along the prohibited lines of legislative activity should become so substantial as to impel the Internal Revenue Service to attribute such activities back to the constituent society. As a matter of law I believe it would be very difficult,

if not impossible, to attribute the activities of this separate organization, controlled through an independent board of directors, back to the constituent members. I believe that EJC acts thus as an insulation for the constituent members. It would seem still more difficult for the Internal Revenue Service to attribute the activities or classification of one of the constituent members through EJC back to another constituent member. In the last analysis the classification of each society stands on its own feet and depends upon the purposes and activities of the organization in question.

In this connection I should perhaps point out that there are certain provisions of the Internal Revenue Code which would operate on a trade association as well as on a scientific one. For example, the tax on so-called "unrelated business taxable income" would be imposed equally on either type of organization. On the other hand the denial of exemption, on the ground that income has been accumulated to a point unreasonable in amount or duration, or that such accumulations are being used or purposes or functions other than those constituting the basis for exemption, appears to relate only to organizations falling under Section 501(c) (3), such as educational and scientific organizations.

As to the effect of a change in classification on UET, I am not familiar enough with its organization and classification to express an opinion and perhaps this question should be submitted to its counsel. I believe, however, that it also is classified as an educational or scientific organization based upon its own purposes and activities and that the classification of the societies which furnish the trustees should not be controlling. If your Society pays rent to UET and you were held not to be organized exclusively for scientific or educational purposes, the proportionate part of the building occupied by your Society might be subjected to New York City real estate tax.

Finally, on the question of the proposed change in the name of the committee to "Task Committee on Economic Advancement," my opinion is clear that no such change should be made so long as the Society is classified as an educational and scientific organization. One of the principal arguments made by the Treasury Department in the course of our conferences on the change in classification was that the Society devoted at least a part of its activities to the economic betterment of its members and the Government conferees cited the names of several of your committees in support of this conclusion. Fortunately we were able to convince the conferees that they had misunderstood the titles and that none of these committees did in fact engage in any activities, whose purpose was the economic betterment or advancement of the members. It is difficult to see how this proposed name could be explained away.

Much the same can be said about the name "Task Committee on Professional Advancement." It may of course be argued that these terms are closely allied to the words used in the constitution which states that the objective of the Society shall be "the advancement of the science and profession of engineering." On referring to my notes covering the Washington conferences I find that this language was discussed, but fortunately taken at its face value by the Government conferees who interpreted it to mean exactly what the words say, rather than to mean the advancement of engineers. However, it seems to me that "the advancement of the profession of engineering" and "professional advancement" mean two different things. In my opinion the

proposed title would be more likely to invite inquiry than the present title. Regardless of the name, however, if the activities of this Committee are in fact directed to the economic benefit of members, the Society will again be vulnerable to the same sort of attack that was made in 1948, with less chance for a successful contest.

Perhaps I should bring to your attention the method used by a number of organizations in the "trade association" classification to solve the problem of deductible contributions, gifts, and bequests. These associations have organized independent funds or trusts whose purposes have been clearly charitable, educational, scientific, and the like, and therefore fall within Section 101(6) of the Internal Revenue Code of 1939 or Section 501(c) (3) of the Internal Revenue Code of 1954. Donors wishing to benefit the Association by making gifts or bequests make them to these funds. This practice has had the express approval of the Internal Revenue Service and I enclose a copy of its ruling on the subject which was issued in 1954 before the new Code was enacted. I believe that the ruling is equally applicable under the Internal Revenue Code of 1954 because within the last few weeks my firm has received a letter denying one of our clients classification under Section 501(c) (3) but suggesting that a separate fund be established.

If I have not covered all the questions which you and the Committee had in mind, please let me know.

Very Sincerely yours,

/s/ Ben R. Clark

BRC"M
Enclosure

Revenue Ruling 54-243

Organizations which are exempt under section 101 of the Internal Revenue Code, other than section 101(6) of the Code, may establish a separate fund exclusively of religious, charitable, scientific, literary, or educational purposes, apart from other funds. If such separate fund is operated exclusively for such purposes, separate books and accounts are maintained, and it otherwise meets the requirements for exemption under section 101(6) of the Code, contributions to the fund are deductible by donors in computing their taxable net income in the manner and to the extent provided in section 23(o) or 23(q) of the Code. A fund of this character should be organized in such a manner that its assets cannot be used, upon dissolution or otherwise, for the general purposes of the organization creating it but must be used for purposes similar to those of the fund itself. The status of such a fund should be established in the manner provided under section 39.101-1 of Regulations 118.

APPENDIX D

Davidson, Dawson & Clark
Counsellors at law
63 Wall Street
New York 5, N. Y.

COPY July 26, 1957.

Mr. E. L. Chandler
Assistant Secretary
American Society of Civil Engineers
33 West 39th Street
New York 18, New York.

Dear Mr. Chandler:

I have spent some time in legal research on the question you recently raised concerning the possibility of organizing a separate corporation or possibly an unincorporated association which could perform acts which are prohibited to the Society under its present tax classification. I have not been able to come up with anything more definite than the oral opinions which I have previously given to you.

These are in brief that if such an organization were a subsidiary, an affiliate or closely associated with the Society it is reasonable to believe that the Internal Revenue Service would attribute its activities to the Society itself. This would be particularly true if the new organization was made up of members of your Board of Direction or subject in any way to their control. In such case, the new organization might be regarded as the agent of the Society and under the law of agency the principal is generally responsible for the acts of his agent.

On the other hand, I believe there are instances where organizations, somewhat related to but entirely independent from exempt organizations, have been created and do act independently of the exempt organization. I have in mind, for example, organizations of alumni who furnish assistance to qualified athletes, where financial assistance by the university would be improper. I am asking my associate, Mr. Searle, to make a further research on this question to see if any such organizations have ever been the subject of litigation. I have been unable, to date, to find any tax cases involving this question. We shall report to you further after this research has been completed.

Very sincerely yours,

/s/ Ben R. Clark

BRC:em

Paper 1491 December, 1957 BD 2

Journal of the
BOARD OF DIRECTION
Proceedings of the American Society of Civil Engineers

TOMORROW'S ENGINEERING PROBLEMS[a]

C. C. Furnas[1]
(Proc. Paper 1491)

SYNOPSIS

Reputedly, engineering is not the oldest profession, but it does have an honorable history which goes back very far indeed, long before degree-granting institutions recognized its substance, its science, and its art. Its monuments are Egyptian pyramids, Roman aqueducts, and Aztec irrigation networks. It has fused human knowledge with human needs and forged the alloy of physical progress, over tens of centuries.

Since human beings are seldom completely satisfied with what they have, the engineer's job is never-ending. Some new device or structure or process is always desired or needed. The burden is further multiplied by the fact that one solution frequently creates a series of new problems which must in turn, at some time, be solved. These new problems created by old solutions are the subject of this paper. More specifically, the paper concerns the use of natural resources—energy, minerals and water.

Very few people or organizations are facing squarely the problems arising from the voracious appetite of a truly technological age for the limited natural resources of this insignificant planet. After only about two generations of really intensive use of its resources, America is already beginning to see a few danger spots. The water table in the West is dropping at a distressing rate. The nation's high-grade copper deposits are already gone and the domestic top-grade iron ores are nearly so. Manufacturers are beginning to use lower-grade ores at considerable expense, and to rely upon foreign sources. The United States now imports millions of barrels of petroleum per year to help keep up with the demands of over sixty million motor vehicles. The use

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a. Address at the Meeting of the American Society of Civil Engineers, Buffalo, New York, June 3, 1957.

1. Chancellor, University of Buffalo, Buffalo, N. Y.

of petroleum has increased by two hundred and fifty percent since 1940 and the curve is still steeply rising.

Problems such as these, though not simple to solve, might still be readily manageable if the United States alone were involved. However, there are many other people in the world and nearly all of them are seeking to achieve the standard of living which American industry has shown to be possible. Inevitably this will lead to ever-increasing demands on the natural resources. Even if Americans would, they cannot ignore the pressure of the hundreds of millions in the rest of the world who would get something more out of life than they do at the present. It is not just an item of social justice—it is primarily the practical matter of arriving at, and maintaining, a reasonably peaceful civilization.

A little simple arithmetic will indicate the magnitude of the problem. The United States has about one-fifteenth of the world's population and, as a rough estimate, produces and uses some fifty percent of the world's industrial goods and services. Thus, the average American utilizes fifteen times as many manufactured goods and services as the average citizen of the world. Hence, to bring the entire world citizenry up to par, by present American standards, would require a world-wide, seven-hundred-fifty-percent increase in total world production of manufactured goods and services; which would mean proportional increases in the use of natural resources.

In addition, this is a period of explosive population growth. At the present time there are over two and one-half billion people in the world. Within the next hundred years (that is only three generations), the world population will almost inevitably rise to at least six billion and the figure may be as large as eight billion. In the United States the present one-hundred-sixty-five million will, by the third generation, have increased to three hundred seventy-five million, even if the rate of increase by that time should have dropped down to zero.

As the population of the world becomes more dense, more and more reliance must be placed upon industrial production, because it will not be possible to support such a tremendous number of people with the old pattern of subsistence agriculture. The per capita use of the natural resources will increase very rapidly. Thus, the total demands will increase much more rapidly than does the population. All of these sociological trends point up some very serious technological problems which will be facing the nation sooner than most people think. The engineer will necessarily be a major factor in solving these problems.

Professor Harrison Brown, of the California Institute of Technology, puts a neat summary in two paragraphs as follows:

> "Machine civilization will in this far future, as we have seen, be fed entirely by the processing of lowest common denominators—air, sea water, ordinary rock and sunlight. By this time population densities will have risen to the point where a great deal of water will be distilled from the sea for agricultural and industrial purposes, and most food will be grown using artificial fertilizers. Metals such as iron, aluminum, titanium, manganese, copper, tungsten and lead will be obtained from rock; this raw material will also provide the major source of phosphorus. The waters of the seas will provide magnesium, chlorine, bromine, iodine and sulfur. Energy will be provided by the uranium and thorium of rocks, by the rays of the sun and conceivably by controlled

thermonuclear reactions utilizing deuterium extracted from the oceans. Liquid fuels and the whole complex of organic chemicals and plastics will be produced from the carbon of limestone utilizing either atomic energy or controlled photosynthesis—probably both.

". . . As our dependence shifts to such resources as low-grade ores, rock, seawater, and the sun, the conversion of energy into useful work will require ever more intricate technical activity, which would be impossible in the absence of a variety of complex machines and their products—all of which are the result of our intricate industrial civilization, and which would be impossible without it. Thus, if a machine civilization were to stop functioning as the result of some future catastrophe, it is difficult to see how man would again be able to start along the path of industrialization with the resources that would then be available to him. We are rapidly approaching such a 'point of no return'." (From: Resources of the World—A Speculative Projection. California Institute of Technology, 1956)

Energy

There are a few who will deny that the energy demands of the world will keep increasing—and rapidly. When you begin making quantitative estimates of the future demands, however, one can get into some substantial arguments. The writer's estimate is that, within the next hundred years, the world demand for energy will increase by at least fifty-fold over that at present. Further, within the next thirty years, the energy demands will increase by at least ten-fold. Though Americans still have a great deal of energy available in the form of the fossil fuels (coal, oil and gas), in many parts of the world the supply is not great enough to meet these rapidly rising demands for very long. Already the undesirable effects of inadequate energy supply are apparent in certain parts of the world and the pinch will become more severe with each passing year. What are the engineers going to do about it?

Fortunately, adequate knowledge for harnessing the atom for the production of nuclear power has come just in time. Large-scale use of nuclear power is inevitable. The only question is when. The time of utilization will vary throughout the world. In the United States at the present time the cost of electric power with the best available design of nuclear power plant would be at least fifty percent greater than can be realized with conventional, coal-fired steam plants. This makes the proposition economically unattractive—at the moment. On the other hand, in England, where the cost of power from fossil fuels is about twice what it is in the United States, nuclear power plants look very attractive, indeed. Hence, England is promoting the use of nuclear power much more rapidly than is the United States. However, since new developments take a long time, that it would not be wise to delay development of large-scale nuclear power plants. By following such a policy, the United States may get caught short-handed in its energy supply.

The present nuclear plants are based on the fission of uranium. Uranium, even though it seldom occurs in high concentrations, is widespread throughout the world and there is an adequate supply to last for at least several hundred years. So when we do go into extensive use of nuclear power, there is no need to worry about the supply for a few generations.

Research people, however, are not satisfied with what is immediately available and they keep pushing forward into new domains. A great deal of intensive research is underway on controlled power production from fusion, i.e. the thermonuclear (hydrogen bomb), reaction. Though no practical method is yet in sight, the researchers are rather optimistic. There is a good probability that this thermonuclear reaction can be harnessed, for practical purposes, within the next generation. The writer feels that the basic research answers will have been obtained within the next decade. This, of course, is pure speculation, but the history of past successes in difficult fundamental research lends substance to the optimism.

This thermonuclear reaction is based on the use of deuterium, or heavy hydrogen, which is present in small amounts in all water. Hence, the supply of deuterium is practically infinite. There is no need to worry about its depletion.

If the harnessing of the thermonuclear reaction is successful, the resulting power plants will probably be very expensive but they will probably be able to produce tremendously large blocks of electric power, at very little cost. Such a development might very well bring about a true revolution in the production and use of electrical power.

Nuclear power plants, however (whether they use uranium or deuterium) will supply only part of our needs for the future. What of liquid fuels? Increasingly, life depends upon the use of the portable power plant in the automobile. There is no indication that man will ever be able to dispense with motor cars. Further, there is no present indication that man can get along without the liquid fuel which drives these portable power plants. Nuclear power plants do not produce gasoline. What can engineers do about that? Even if they discover great new pools of oil and tap mammoth deposits of oil shale, engineers must find an answer to that question in a matter of years—not generations.

It is time to begin looking more intensively at the natural processes which produced the fossil fuels in the first place. Through the process of photosynthesis, the energy of sunlight promoted chemical reactions between carbon dioxide and water in the plants and thus chemically stored the energy which is now used in the form of coal, gas and oil. This storage process took place a few hundred million years ago. If man were clever enough, perhaps he could harness this sunlight process to a sufficient extent to meet current needs. However, scientists do not yet have enough research information to carry out such artificial photosynthesis on a practical scale. Research is beginning to point the way to an understanding of the photosynthetic process, but it is still progressing much too slowly. More effort needs to be applied. If scientists should learn to capture and utilize solar energy effectively in this way, there would be an ample supply of energy. At the present time about thirty-thousand times as much energy falls on the surface of the earth every day as the entire human race utilizes in the same twenty-four hours. It is time that the engineers began to think seriously about the best ways and means of utilizing this tremendous energy supply for the production of liquid fuel.

But solar energy has its shortcomings. It is not very concentrated and the supply is intermittent. So, for an eventual liquid fuel supply perhaps another string should be added to our bow. Here is another suggestion, for whatever it may be worth. When engineers begin using nuclear power plants, a tremendous amount of excess energy will be available in the form of neutron and gamma radiation which will be largely wasted, except as it appears in the

form of heat. In all probability there are a number of chemical reactions which, by photochemical processes, could utilize the neutron and/gamma radiation, and store the energy in the form of chemical compounds, very much as the energy of the sun is stored in the chemical compounds of plants through the photosynthetic process. Perhaps some of these photochemical reactions could produce satisfactory liquid fuels from carbon dioxide and water, or other commonly available chemicals. Very little chemical research has been done along this line. It is my feeling that engineers should begin to find out what the possibilities are. The Russians apparently are progressing more rapidly along this line of research than Americans are.

To sum up the energy picture, just as mankind has begun truly extensive utilization of the supplies of fossil energy, which nature so kindly provided, that supply approaches the point of partial depletion. Research is progressing on the harnessing of new forms of energy, particularly nuclear energy, but a tremendous amount of research must still be done before engineers can arrive at practical means for fulfilling future needs. The engineer must follow closely behind the research scientist, to implement the proper applications. Time is short because the necessary new developments will take a long time and the hot breath of a rapidly expanding technological civilization is already on our necks.

Minerals

Fortunately, there is the so-called Law of Conservation of Matter, which is true as a first approximation, and adequate for present purposes. This Law states that no matter is ever destroyed. Materials never disappear; they merely change their location, their concentration, or their chemical combination. Hence, the depletion of mineral resources, means only that they are not in the concentration, or the location, or the chemical form in which we would like to have them. The Law of Conservation of Matter makes it feasible for the research men and the engineers to be optimistic about the solution of mineral problems, even as the great natural deposits approach depletion. It will be necessary to go where the minerals actually are and dig them out by newer and better processes.

Harrison Brown mentioned the necessity of learning to process and use the materials found in the low-grade rocks.* This is going to call for new approaches to the handling of materials; particularly new and clever processes for the selective extraction of the values which are needed. For instance, one ton of average granite (which comprises a large proportion of the rocky crust of the earth) contains about four grams of uranium and about forty grams of thorium (approximately four and forty parts per million respectively). If that uranium and thorium could be extracted and used in a nuclear power plant, each ton of granite would produce as much energy as fifty tons of coal. The only trouble is that there is no known method of extracting those minute quantities of uranium and thorium in a practical manner. Here is a chore and a challenge to both the research man and the engineer.

One could go down the line on a large number of those other desirable minerals which are present throughout the crust of the earth, but only in very low concentrations. Industrial civilization thus far has been living high off the

*Ibid.

hog by exploiting the concentrated deposits of the desirable minerals. Engineers will now need to become progressively more ingenious and recover metals and other minerals from the less favorable sources. Further, this must be done on a practical and economical basis if industry is going to make use of these low-grade raw materials. The problem of mineral recovery from dilute sources is one of the greatest challenges to industrial civilization.

In his quest for his minerals, man does not need to confine his attention to the grimy and solid rocks. He can also look to the sea. The oceans cover about five-sevenths of the earth's surface to an average depth of about thirteen thousand feed. For practical purposes, the sea is practically infinite in extent, and it contains some of most of the chemical elements, albeit many of them are there in very minute concentrations. Already American industry is tapping the sea for two minerals: bromine (which is used in the production of ethyl fluid for gasoline) and the metal, magnesium. These materials are being recovered from sea water in very substantial quantities, and profitably. What are the other possibilities? With the present state of the art and scientific knowledge, the extraction of other minerals from the oceans does not appear to be feasible. But, scientists have not yet progressed very far. Here again, much remains to be learned from nature, because many of her organisms have evolved an art of concentration of minerals from sea water and have carried it to a high degree of effectiveness. Oysters, for instance, build up a concentration of copper on the interiors of their gelatinous bodies which is several hundred-fold greater than it is in sea water. Ordinary kelp (one variety of seaweed) builds up high concentrations of both potassium and iodine. Perhaps the gourmet does not care to think about it but the lobster has a concentration of iodine in its interior structure which is several hundred thousand times greater than that of the surrounding sea water. The slimy sea cucumber is a stupid and unattractive fellow, but he is able to store up ten percent of vanadium in his respiratory tract. This is many thousand-fold more concentrated than it is in the sea water in which he lives. If one understood the base-exchange and other selective processes which are going on in these low organisms, one might very well find practical ways of recovering large quantities of various minerals from the sea. Engineers would have to handle a great deal of water and would have to use a great deal of energy and employ large apparatus, but there is nothing insurmountable in the problem, provided he has the adequate basic knowledge. The stakes are high because mineral needs are great and growing greater. Fortunately, the ocean which laps the shore of practically every country in the world contains essentially an infinite supply of a great many of the things needed.

Water

Many of the wilder and bloodier stories of the old West centered around the battle for the old water hole. Particularly in the Southwest, this situation still holds and is getting even worse. By means of dams, wells, irrigation ditches and even feeble attempts at controlling the weather, engineers try to solve their water problems. But they are losing ground steadily as more and more people move into the region, bringing increased industrial and agricultural demands. This inadequacy of one of the most necessary natural resources is ever present today. Man doesn't need to wait until tomorrow to start worrying about it. The situation in some other parts of the world is even worse.

To meet this water problem one might say there is always the ocean, but the trouble is that sea water happens to contain about three and one-half percent of sodium chloride plus small amounts of a host of the other substances. How can fresh water be derived from salt water, on an economic and practical basis? That is the question.

Many people in the United States have recently become very much interested in this problem. There has been substantial, though in my opinion, inadequate, Federal support for these investigations. The problem has been approached through the old conventional processes, with heavy emphasis upon evaporation. There have been some feeble attempts at the development of solar stills by which the required energy is supplied for nothing—when the sun shines. Research has nibbled moderately at electrochemical and selective diffusion processes of different kinds, but it has not carried the work far enough. The best processes developed to date can produce fresh water from salt at a cost which is somewhere between five and ten times that which is now considered acceptable for industrial and agricultural uses. This is not to say that ultimate success is impossible, but it must be confessed that at the moment it is rather discouraging. It would appear that some new approaches are needed. The recovery of fresh water from the sea is one of the major challenges to the applied research man and the engineer of today.

The Consolidated Approach

To this point, the writer has built up a moderately discouraging picture. Nuclear power plants, synthesis of gasoline by means of sunshine or nuclear energy, recovery of valuable metals from common rocks and from sea water, pure water from the briny ocean have all been mentioned and admitted to be impractical in the present technological and economic structure. But who will deny that scientists and engineers must solve these problems some day? The real question is—how soon? The writer firmly believes that they should be starting on them NOW.

Admittedly, a great deal of research and engineering development will have to be accomplished before these individual processes will be practical, by themselves. On the other hand, a page could be taken from the book of those industries which have found that their survival depends on doing several things at once—they survive on their by-products.

Visualize what might be done with an industrial complex built around a large nuclear power plant located on a seashore. Such an establishment, if organized in an appropriate manner, might operate profitably by producing the following:

1. Electrical power.
2. Liquid fuel, which would be produced by the photochemical reactions of neutron and gamma radiation on carbon dioxide and water, or similar materials.
3. Fresh water from sea water, which would be produced by a combination of electrochemical operations, diffusion and evaporation which would utilize the waste heat from the nuclear reactor.
4. A number, say ten, of the valuable minerals which would be extracted from the sea water which had already been processed for its fresh water. This extraction would involve base-exchange mechanisms and other selective physical and chemical processes.

All this would require large and complicated apparatus, many parts of which cannot be visualized as yet; and it would call for an industrial organization which would be unique from the present point of view. However, the laws of nature, and man's technical competence might very well permit engineers to carry out such a consolidated operation on a practical basis. It would be a significant step toward solving some of the major problems of the supply of natural resources. This is only one suggestion. Perhaps there are other and better approaches. But whatever combination of processes is finally arrived at, enough engineering problems are involved to keep a great number of competent individuals busy for a long time.

Urgency and Complexity

In the foregoing the writer has suggested several important problems, but has offered no satisfactory solutions. True to the title of the paper he has posed only tomorrow's engineering problems; he has not solved them. The utilization of natural resources is only one of the many problem areas which face the engineers of tomorrow. There may be a shortage of good engineers but there will not be any shortage of problems for good engineers to solve.

American industry has done very well indeed in the past, by waiting until problems were immediate before it began to solve them. It probably feels that it has been very practical in this matter because it has let other people do the worrying. The practical engineer and the industrialist have been called in only when the need was established beyond any shadow of a doubt. However, this practical pattern of the past may be a very dangerous one for the future. If problems such as these are neglected, it will take a long time to solve them. If this nation is to maintain its industrial dominance, it would be well to have the solutions to some of the more severe problems in hand as soon as possible. Otherwise, its citizens may wake up some bright morning and find themselves just watching the rest of the world go by.

Education

The solutions to these problems are certainly not to be found in handbooks; nor do they reside in any one segment of science or engineering. New principles must be discovered and understood. There are complex cross-linkings of what is now considered to be the conventional mental disciplines. Perhaps a new type of knowledge and understanding is needed on the part of the engineers.

Do the graduates of engineering colleges have enough basic understanding of natural phenomena, enough breadth of vision, to solve tomorrow's problems? If not, are teaching methods inadequate? They may be. Must the student spend an increasing amount of time on formal education? But time of active professional life is already so short; educators can't go much further along that route.

However the physical and curriculum pattern of engineering schools may change, it is obvious that tomorrow's engineers must reconcile themselves to the fact that their education, in some form, must continue throughout their professional careers. There must be a growing, close collaboration between industry and universities, if engineers are to do the job properly. This may

very well call for increased financial support and executive effort from corporations. It might be well to look at the matter squarely. Problems are not solved by evading them.

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ABSTRACTS AND INDEXES FOR PROCEEDINGS, VOL. 83, 1957

(Proc. Paper 1493)

FOREWORD

This index has been prepared in an effort to supply a list of topic headings as a guide to material published in the Proceedings of ASCE during 1957. The abstracts included herein are presented to indicate to the reader what general information can be found in the paper in question. The author listing has been made as complete as possible and includes the names of co-authors, discussers, and committee chairmen of the several reports. Subject headings have been greatly restricted, for the sake of brevity, under three basic rules:

1. Each paper is listed under one primary heading suggested by the name of the technical divisions of the Society. No other entry is made for the paper if that one entry is considered to be sufficient.
2. A secondary listing is used if further classification is essential. In this second listing an attempt is made to place papers published in one Division's Journal also under another Division's name so that readers of the Journal of one Division can be made aware of other papers that might be of interest to them.
3. A geographic listing (by states of the United States and by foreign countries) is recognized where location is of particular importance.

References to discussers of a given paper can be found immediately under the name of the senior author in the author index. Discussion that occurred in more than one calendar year can be traced by referring to the senior author's name in sucessive indexes, until the closing remarks are located. If discussion is published in the same year as the paper, the listing of this discussion is made directly after the listing of the paper in the subject index. If the discussion appears in the year following the paper's publication, then the subject indexing of that discussion is made in alphabetical order under the appropriate subject heading.

Typical abbreviations used in this index are: Dsc for "discussion," Clo for "closing discussion," Rt for "report," Corr for "corrections," and Chmn for "chairman" of a committee submitting a report. All numbers refer to the number of the Proceedings Paper, no page numbers are included in this index. Immediately following the Proceedings Paper number, the letter and number

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symbols indicate which of the several Division Journals the particular paper appeared in. By referring to the back inside cover of any Division Journal the month of issue of any Journal can be ascertained.

Items indexed are identified by months as follows:

Month	Number
January	Proc. Papers 1136 to 1161
February	1162 to 1185
March	1186 to 1195
April	1196 to 1230
May	1231 to 1259
June	1260 to 1288
July	1289 to 1329
August	1330 to 1351
September	1352 to 1386
October	1387 to 1425
November	1426 to 1448
December	1449 to 1493

ABSTRACTS

January

1136. Population Estimates for the State of Oregon, by George W. Reid. (CP) Population estimates for Oklahoma for the years 2000 and 2050 are based on the premise that United States population will grow following theoretical patterns and that this growth will cause migration to less populated areas. These estimates are presented as a guide to future development of Oklahoma with emphasis on water-resource development.

1137. The City Planner in Pittsburgh's Renewal Projects, by Patrick J. Cusick, Jr. (CP) This paper describes extensive contributions that have been made toward rebuilding blighted urban areas under redevelopment powers. Substantially expanded activities in this field are a result of introducing the renewal concept in the Federal Housing Act of 1954.

1138. The Boundary Layer Development in Open Channels, by J. W. Delleur. (EM) Development of a turbulent boundary layer is analyzed theoretically for the case of a steady flow in a horizontal open channel. The problem is solved for a rectangular cross section. A simplified solution is given for a channel of larger width, and the theory is compared with experimental results.

1139. Approximation to Plastic Behavior of Circular Membranes, by N. A. Weil. (EM) An approximate theory is presented for plastic behavior of clamped, circular membranes subjected to lateral hydrostatic pressures. The von Mises-Hencky relationships are taken to govern the plastic behavior of the material; suitable approximations are adopted for the biaxial stress-strain and strain-displacement laws.

1140. Lateral Buckling of Plane Frameworks, by E. F. Masur and A. Cukurs. (EM) The stability of trusses against buckling perpendicular to their plane is analyzed. Following derivation of basic relationships, a "series criterion" of stability is established. It is demonstrated that the customary method of equalizing the slenderness ratios of compression members in both directions may lead to unbalanced design.

1141. Wind Induced Vibration of Cylindrical Structures, by Joseph Penzien. (EM) This paper presents the results of an investigation to determine the dynamic behavior of cylindrical sections under the action of wind at high Reynolds numbers. These results show that wind-induced vibration normal to the direction of wind is "self excited" rather than "forced." Two critical wind velocities were observed.

1142. Laboratory and In-Situ Permeability of Sand, by Charles I. Mansur. (SM) Seepage analyses and design of seepage-control measures require accurate knowledge of the permeability coefficient of the sand strata involved. Results of laboratory tests on remolded sand samples are compared with permeabilities obtained from field pumping tests.

1143. Seepage Through Foundations Containing Discontinuities, by Elbert E. Esmiol. (SM) Four case histories show that earth dam foundation materials may be disrupted by discontinuities. These depositional, erosional, and structural forms complicate seepage control. Successful, rationally conceived, remedial measures for specific seepage problems are presented.

1144. Consideration of Pore Pressure in the Stabilization of an Ore Pile, by Karl Terzaghi and Ralph B. Peck. (SM) Instability of the track supporting one end of an ore bridge in a steel plant was caused by excess porewater pressure in a layer of silt. A succesful permanent system of vacuum well points was installed after preliminary field tests demonstrated the feasibility of draining the silt in this manner.

1145. General Aspects of Cement Grouting of Rock, by V. L. Minear. (SM) Past experience of cement grout-

ing of rock foundations in the United States is reviewed. Pertinent items as to what constitutes the best practice in cement grouting, and their pros and cons, are presented. Examples are given of experience on construction projects and of current practices and techniques used in pressure grouting.

1146. Effects of Cambering of Steel WF Beams, by Harry H. Hill. (ST) Cambering steel beams is usual today in simple span bridges. Although residual stresses are disregarded by design procedure, they are of sufficient magnitude to be considered.

1147. A Circuit Analysis of Laterally Loaded Continuous Frames, by Frank Baron. (ST) A distribution procedure, complementary to moment distribution, is developed for structures lying in a plane and having curved or segmental members forming any number of multiconnected circuits in the plane. The procedure is based on the same geometrical requirements as in column analogy and shear and torsion analogy.

1148. Fatigue Tests of Riveted or Bolted Aluminum Alloy Joints, by M. Holt, I. D. Eaton, and R. B. Matthiesen. (ST) Fatigue test results for aluminum-alloy monobloc specimens, butt joints, and lap joint indicate that specimens with idle rivets have higher fatigue strengths than those with open holes; that symmetrical joints have higher fatigue strengths than unsymmetrical joints; and that joints with tightly drawn bolts or flush-head rivets have higher fatigue strengths than joints with protruding-head rivets.

1149. Shearing Strength of Reinforced Concrete Slabs, by Nan-Sze Sih. (ST) Based on a study of tests made by different investigators, the shearing strength of reinforced concrete slabs may be predicated by the criteria proposed in this paper. These criteria indicate that Talbot's method is applicable only within a limited range of the design.

1150. Behavior of Riveted Connections in Truss-Type Members, by E. Chesson, Jr., and W. H. Munse. (ST) The tests reported in this paper provide information on the general behavior of large truss-type riveted-steel connections; the test program includes specimen configuration, method of hole preparation, and size of rivets. A study is made of the comparative behavior of the specimens, the distribution of load to the gusset plates, the strains in the lacing bars, the effect of hole preparation, and the predicted and computed efficiencies of the connections.

1151. Choice of Composite Beams for Highway Bridges, by Harry Subkowsky. (ST) This paper presents a series of preliminary design charts for the rapid selection of rolled beams and cover plates used as stringers in simple-span composite highway bridges. A description of the charts, their uses, and the assumptions made in their development is given.

1152. Discussions of Proceedings Papers 509, 510, 710. (CP) No closure to 509. W. R. B. Froehlich closure to 510. No closure to 710.

1153. Sector Analysis for Concrete Pavement Load Stresses, by Bengt F. Friberg. (HW) Sector analysis is outlined, which is an approximation method of elastic analysis for slabs subjected to tire-imprint loads and resting on yielding subgrades and is used for loaded-area dimensions and for slabs of limited dimensions. Principles and procedures are described.

1154. Discussions of Proceedings Papers 797, 1031, 1032, 1073. (EM) Corrections to 797. W. M. Lansford and J. M. Robertson; C. J. Posey on 1031. R. V. Hauer, C. J. Posey, C. M. Segedin on 1032. R. L. Ketter on 1073.

1155. Discussions of Proceedings Papers 754, 842, 861, 866, 1025, 1026. (SM) No closure to 754. H. B. Seed and L. C. Reese closure to 842. A. R. Jumikis closure to 861. G. G. Meyerhof closure to

866. H. R. Cedergren; R. B. Peck and H. O. Ireland on 1025. E. J. Zegarra, R. L. McNeill on 1026.

1156. Discussions of Proceedings Papers 762, 851, 869, 915, 1019, 1020, 1022, 1054. (ST) No closure to 762. H. A. Sawyer, Jr., closure to 851. N. E. Landdeck closure to 869. E. L. McDowell, K. E. McKee, and E. Sevin closure to 915. G. S. Vincent, L. Balog, G. K. Gillan on 1019. J. Chinn on 1020. T. Au, H. S. Schick, Z. Sobotka, M. Spanovich, S. M. Ulicny on 1022. W. Lum on 1054.

1157. A Pressure Line Concept for Inelastic Deformations, by Frank Baron. (EM) The concept of the pressure line is developed for quickly estimating the effects of plasticity on the behavior of structural elements subjected to axial and flexural loads. An initial estimate, obtained by means of an elementary theory of mechanics, is adjusted to fit the conditions of plasticity.

1158. The Infinite Elastic Beam on a Linear Viscoelastic Foundation, by Alfred M. Freudenthal and Harold G. Lorsch. (EM) The infinite, elastic beam on three different types of linear viscoelastic foundations is analyzed under various loads. Initial, transient, and terminal states of beam deflection and foundation pressure are determined; numerical examples with graphs are given; and the extension of the results to finite beams is discussed.

1159. Moisture Conditions Under Flexible Airfield Pavements, by J. F. Redus. (SM) Investigation of moisture conditions under flexible airfield pavements over a period of years indicates that base course and subgrade moisture contents become stabilized after about two years. Moisture contents in the upper 18 in. were found to be unrelated to rainfall, but those at 30 in. appeared to be related to rainfall.

1160. Frictional Resistance of Steel H-Piling in Clay, by Eben Vey. (SM) A steel H-pile instrumented with strain gages was driven 50 ft through medium clay into hard soil and load tested. Results were found in good agreement with unconfined compression data provided the shear perimeter was taken as twice the distance between flanges.

1161. Relative Density and Shear Strength of Sands, by T. H. Wu. (SM) Relative density of natural sand deposits was investigated by tests on undisturbed specimens taken at regular intervals throughout the deposits. Results were correlated with the grain-size characteristics and with the penetration resistance. Triaxial tests were made to evaluate the influence of the relative density of the shear strength.

February

1162. Measuring Streamflow Under Ice Conditions, by A. M. Moore. (HY) Effects of ice formation on stage-discharge relationships are explained briefly. Occurrence and effect of surface, frazil, and anchor ice are described, and recorder graphs registering these effects are shown. One investigation of "siphon action" is detailed, and factors affecting the accuracy of ice-affected records are listed together with a general appraisal of such accuracy.

1163. Pipe Friction Loss at High Pressures, by J. G. Slater, J. R. Villemonte, and H. J. Day. (HY) Pipe-friction tests were conducted at line pressures up to 2,000 lb per sq in. Friction factors are compared with standard pipe-friction theory for a range of Reynolds number of from 146 to 135,000 computed with viscosities measured by Stokes-Law apparatus, showing a small but consistent deviation for results obtained at 2,000 lb per sq in.

1164. Some Physical Problems Related to Flood Insurance, by A. Arthur Koch. (HY) Some of the technical and scientific problems, in the fields of meteorology, hydrology, and oceanography, of a nationwide flood insurance program are described. The solution of these

problems will depend largely on theoretical and experimental knowledge accumulated within the past two decades.

1165. Technical Problems of Flood Insurance, by H. Alden Foster. (HY) Flood insurance is outlined from the engineering standpoint, with emphasis on determining flood probability from relatively short records, estimating mean annual flood damage to properties for establishing self-supporting premium rates, spreading the risk of flood damage over a large number of policies, and technical problems of setting up a program of flood insurance.

1166. Frequency Analysis of Streamflow Data, by David K. Todd. (HY) Frequency analysis of streamflow data is reviewed, and computational procedures are briefly outlined, but with a list of references. Frequency analysis of high flows (floods), low flows (droughts), and all flows are described. Figures illustrate methods of expressing and interpreting streamflow data subjected to frequency analysis.

1167. Butterfly Valve Flow Characteristics, by M. B. McPherson, H. S. Strausser, and J. C. Williams, Jr. (HY) Flow coefficients are given for free and submerged discharge and for two cases with enclosed flow piping. Effects of type of installation, blade shape, and closure angle for control-type valves (using water) are demonstrated. Correlation of analytical relationships with performance provides a basis for predicting incipient cavitation.

1168. The Sanitary Engineer of the Future, by T. V. Hatch. (SA) Rapid technological expansion is creating a field widely divergent from that of early civil engineering. The sanitary engineer must expand his knowledge of the newer aspects of technology as they affect invironment; the sanitary engineer of the future will meet these new and varied problems.

1169. Basic Considerations in the Measurement of Air Contaminants, by Wesley C. Hemeon. (SA) Conventional measurements of air contaminants are discussed as well as the filter paper black stain sampler and obtainable data.

1170. The Relationship Between Consulting Engineers and Industry, by David H. Miller. (SA) The salesman-customer relationship exists between engineers and industry. For the most part, the consultant supplies specialists to aid the industry in solving problems. This is done in a completely professional manner rather than a purely commercial manner.

1171. Effects of Storage Impoundments on Water Quality, by Milo A. Churchill. (SA) This paper presents and summarizes a wide variety of observations made on reservoir waters in the Tennessee Valley during the past twenty years. The facts obtained and the general principles deduced therefrom should help forecast the changes in water quality that are likely to occur in any proposed reservoir.

1172. Sludge Incineration, by Mark B. Owen. (SA) Sewage sludges are similar to low-rank fuels and may be burned without obnoxious gaseous odors. Chemical characteristics of wastes and combustion computations for sludge are provided. Multiple-hearth furnace operating data are tabulated and discussed. Preferred furnace design criteria are quoted, and the design and operation of the Nichols Herreshoff furnace are described.

1173. Sludge Digestion or Incineration, by Eugene R. Davis. (SA) The factors determining the economics of digestion versus incineration are so dependent on local conditions that no general conclusions can be reached for all conditions. It is shown that each problem is specific in itself.

1174. Calculation of MAC of Radioactivity in Air and Water, by Herman Cember and M. A. Shapiro. (SA) Radiation damage is proportional to absorbed energy, which provides a means for computing MAC values for many radioactive environmental contaminants. These values are based on a maximum exposure rate of 300 millirem per week, corresponding to the absorption of 30 ergs

per gram of tissue for beta or gamma radiation. If the biological behavior of any particular radioisotope is known, then the maximum permissible contamination may be computed that would result in exposure at this rate.

1175. Selection of Sites for Atomic Energy Plants, by Arthur E. Gorman. (SA) Careful site selection for atomic energy plants is a most important advance planning function. The most significant environmental elements affecting site selection are the geology, hydrology, and meteorology of the area.

1176. SED Research Report No. 11: Status of Refuse Collection and Disposal, by The Sanitary Engineering Research Committee, Refuse Section. (SA) A preliminary survey was completed during 1955-1956 concerning the present status of refuse collection and disposal as well as future needs for additional research and development. The results of this investigation are summarized and evaluated.

1177. Discussions of Proceedings Papers 716, 826, 838, 1009, 1015, 1034. (HY) Joseph M. Caldwell closure to 716. W. B. Langbein and C. H.. Hardison closure to 826. Ven Te Chow closure to 838. J. E. Flack, John L. French on 1009. Guido di Ricco on 1015. Sam Shulits on 1034.

1178. Some Engineering Aspects of High Rate Composting, by John R. Snell. (SA) Composting, one of the least known methods of garbage and refuse disposal, is currently being considered as an important means of conserving natural resources and of disposing of solid wastes. Factors affecting high-rate composting are cited.

1179. Writing Engineering Specifications—For Quality, Not Price, by Morris M. Cohn. (SA) This paper shows that a major engineering problem in public works is specification writing because stress is too often placed on price rather than on quality. However, there is a tendency to improve specifications so that quality is first and price, second.

1180. Color in Industrial Wastes, by Nelson L. Nemerow. (SA) Modern theories of color formation are reviewed and summarized with special emphasis on the role of chemical structure in color development. Commercial dyes are classified according to their structure. The azo group of dyes, representing about half of the commercial dyes manufactured at present, was selected for experimental laboratory studies. Reduction with $SnCl_2$ and salting with NaCl were most effective in reducing and changing the color of methyl orange, a monoazo dye.

1181. Allegheny County Story of Smoke and Air Pollution Control, by T. C. Wurts and J. J. Grove. (SA) Ever since the 19th century, the Pittsburgh area has been troubled by air pollution. The development of smoke and air-pollution control in Allegheny County is an excellent example of what can be accomplished by cooperative efforts of an entire community.

1182. Arch Dams: Measurements and Studies of Behavior of Kamishiiba Dam, by H. Kimishima and C. C. Bonin. (PO) This paper, one of three, describes the actual behavior of the first large arch dam in the Far East. A description is included of the instruments, their arrangement, and the results of preliminary investigations. Data is presented on joint openings, deflections, stresses, and temperature variations in both concrete and foundation rock.

1183. Arch Dams: Construction of the Kamishiiba Dam, by K. M. Mathisen and C. C. Bonin. (PO) This paper, one of three, discusses the construction of the first large arch dam in the Far East. The construction plant and equipment, foundation excavation and grouting, quarry operations and aggregate production, concrete control, construction operations, contraction joint grouting, and the closure of the dam are described.

1184. A Supplemental Note on Valuation and Depreciation, by Maurice R. Scharff. (PO) This paper supplements two previous papers by the writer by citing the applicability of computations

of equal sums, of present worths of annual fixed charges, and of operating expenses for alternative proposals to the solution of other engineering-economic problems and to the valuation and depreciation of public-utility property. Algebraic formulas and numerical examples are presented for a number of selected typical cases.

1185. Discussions of Proceedings Papers 639, 739, 895, 991, 997, 1042. (PO) Louis E. Rydell and Glenn H. Von Gunten closure to 639. William Whipple closure to 739. Glenn H. Von Gunten, Hugh A. Smith, Jr., and Berton M. MacLean closure to 895. Judson P. Elston on 991. Fred A. Houck on 997. James Park on 1042.

March

1186. The Vibration of Simple Span Highway Bridges, by John M. Biggs, Herbert S. Suer, and Jacobus M. Louw. (ST) An analytical method for predicting the magnitude of highway-bridge vibration due to vehicular traffic is presented. Results obtained by this method are shown to compare favorably with laboratory experiments and actual field tests. Final theoretical results are presented in chart form for practical application.

1187. Analysis of Multiple-Span Continuous Trusses, by Benjamin C. F. Wei. (ST) This paper presents the method of the moment-influence line as a tool in analysing multiple-span continuous trusses. For simplicity and ready adaptation of this method for use in design offices, solutions are given in tabular form. A numerical example is included showing the complete analysis of moment-influence lines for a 4-span continuous truss.

1188. Resistance to Overturning of Single, Short Piles, by E. Czerniak. (ST) This paper presents practical aids for stress analysis and lateral force design of short piles which will effectively reduce the labor ordinarily required for their solution. Specifically, the paper was prepared for those engineers concerned with foundation design in refineries and chemical plants.

1189. Confirmation of Inelastic Stress Distribution in Concrete, by Eivind Hognestad. (ST) Studies regarding inelastic stress distribution in flexure of reinforced concrete members are reviewed, and the results obtained are compared with the recommendations of the Joint ASCE-ACI Committee on Ultimate Strength Design. Test results show that the inelastic concrete stress distribution consists of a rising curve from zero to the maximum stress and a descending curve beyond the maximum stress. The Joint Committee design coefficients are well substantiated by test results.

1190. Design of Flexible Steel Arches by Interaction Diagrams, by Haaren A. Miklofsky and Omar J. Sotillo. (ST) A direct method of structural design for all types of flexible steel arches by means of interaction diagram is presented. The design method is illustrated by the design of the quarter point sections of the following steel arch bridges: The two-hinged Rainbow Bridge, the Bayonne Bridge, and the hingeless Rainbow Bridge.

1191. Prestressed Truss-Beams, by Ralph L. Barnett. (ST) This paper presents a design procedure for simply supported beams which makes possible the utilization of statically indeterminate composite action and favorable initial stress distribution to strengthen available beam sections. A variation of the Queen Post truss with a pretensioned tie rod is studied, and weight savings of more than 30% are demonstrated. The techniques used are based entirely on elastic considerations.

1192. Discussions of Proceedings Papers 764, 825, 828, 914, 920, 1023, 1054, 1055, 1057, 1058, 1100, 1106. (ST) Lynn S. Beedle closure to 764. George F. Collins closure to 825. Alexander H. Kenigsberg closure to 828. Andrew John Pyka closure to 914. George Winter closure to 920. Pranab Kumar Chaudhuri on 1023. A. A. Eremin, C. Neufeld, E. A. Richardson on 1054. R. L. Kemp and A. H. Mattock; Dean Kamaras on 1055. T. Au, W. Watters Pagon, Sandi Pado Bennerjee,

M. G. Salvadori on 1057. John C. Murphy, Thomas D. Y. Fok on 1058. Ludwig Adams on 1100. Thein Wah on 1106.

1193. Design and Strength of Welded Pipe Line Branch Connections, by E. C. Rodabaugh and H. H. George. (PL) The design of pipeline branch connections is on an empirical basis because no suitable theoretical analysis is available. Code requirements, loadings, and field failures are briefly discussed. Extensive test data on pressure and external loadings, both of a static and cyclic nature, are presented.

1194. Flow of Natural Gas in Pipelines, by William T. Ivey and James H. Dorough. (PL) Consideration is given to the various flow formulas used in designing natural gas transmission pipelines. The need for a standard formula based on maximum efficiency against which actual line performance may be compared is emphasized. The merits of a proposed form for this standard equation are presented.

1195. Prediction of Surge Pressures in Oil Pipelines, by Robert D. Kersten and Edwin J. Waller. (PL) This paper outlines a method of analysis of surge problems based on a fundamental mathematical approach. The validity of this method is demonstrated through application to a field-scale pipeline system. Future applications of this method should result in increased knowledge of "surge" conditions, and, hence, in better over-all designs and appreciable financial savings.

April

1196. Bending of a Rectangular Plate with a Free Edge, by William Nachbar. (EM) A rectangular plate, simply supported along three edges and free on the fourth, is subjected to linearly varying lateral pressure. Extensive, exact numerical results are given for deflections, moments, shear and edge reaction force distributions for various geometries and different Poisson's ratios. Approximate, closed form formulas are also developed.

1197. Mechanics of Sediment Ripple Formation, by H. K. Liu. (HY) Literature on the mechanics of sediment ripple formation is reviewed. It is shown in this paper that ripples are caused primarily by the instability of the zone of high velocity gradient at the surface of the sediment-laden bottom. For practical application an experimental criterion is given to predict the formation of sediment ripples and dunes.

1198. Characteristics of a Large Throated Syphon, by J. C. Stevens. (HY) A syphon spillway, having what is believed to be the largest throat dimensions (9.0 ft by 35.6 ft), was designed and piezometrically tested by the author. The paper gives its discharge coefficient, efficiency, primary behavior, and other data. It maintains a constant forebay level at the Portland General Electric Company's Sullivan plant regardless of ordinary floods and load variations.

1199. Ocean Wave Forces on Circular Cylindrical Piles, by R. L. Wiegel, K. E. Beebe, and James Moon. (HY) Forces exerted by ocean waves on circular cylindrical piles were measured at an exposed location near Davenport, Calif., in water 50 ft deep. The waves were as high as 20 ft. The coefficients of drag and mass obtained from these measurements are given, and the significance of their scatter, discussed.

1200. The Estimation of the Frequency of Rare Floods, by Benjamin A. Whisler and Charles J. Smith. (HY) A method of estimating the frequency of annual peak flood flows which uses recorded monthly peak flood flows is suggested. It is shown that the use of monthly peak flood flows approximates the results obtained by using all peak flows but greatly reduces the amount of work involved.

1201. A High Head Cavitation Test Stand for Hydraulic Turbines, by W. G. Whippen and G. D. Johnson. (HY) This paper presents a description of a new closed-circuit "water tunnel" and indicates its value for testing model hydraulic turbines under high heads (up to 300 ft).

1202. Is the Writing of Flood Insurance Feasible, by John F. Neville. (HY) This paper discusses flood insurance from the standpoint of the private insurance industry; reviews the efforts made by private industry to provide such coverage in the past; explains why privately sponsored flood insurance is unfeasible; and reviews the offer of the industry to assist in putting into effect the Federal Flood Insurance Act of 1956.

1203. Infiltration Measurements in Sewers of Small Size, by Robert A. Lincoln. (SA) A rapid and accurate method of measuring groundwater infiltration flows in newly constructed sanitary sewers of small size is discussed. A descrip-

tion is given of the design, fabrication, and calibration of rectangular slit and sutro proportional weirs developed for use on a certain project before the project was placed in service to handle sanitary flows. Use of the apparatus in the field is described.

1204. Field Experiences with Chemical Grouting, by Milos Polivka, Leslie P. Witte, and John P. Gnaedinger. (SM) Many examples are cited of the use of chemical grouts, either to improve the stability of sandy soils or to seal porous strata. They include the use of sodium silicate grouts in constructing tunnels and foundations in free-flowing sand, experience with chrome-lignin grouts at Heart Butte Dam, and experiences with calcium acrylate and acrylamide methylene bis acrylamide grouts. Laboratory control, composition of grouts, and methods of grouting are discussed.

1205. Compacting Earth Dams with Heavy Tamping Rollers, by Jack W. Hilf. (SM) The results of compacting 39 Bureau of Reclamation earth dams by heavy tamping rollers are compared with the laboratory standard compaction test. A statistical method obtaining roller curves from control tests made during construction is presented. The results of this type of analysis on three dams which represent a wide range of impervious soils are given.

1206. An Estimation of the Point Resistance of a Pile, by Yoshichika Nishida. (SM) This paper presents a new method for computing approximately the bearing capacity of a foundation pile by its point resistance in cohesionless soils. Although it is not rigorous from the mathematical point of view, the method seems to give a good estimation of the bearing capacity of a pile after comparing it with practical examples.

1207. Use of Material from Structural Excavations, by Jack W. Hilf. (SM) The design of a rolled earth dam may be influenced significantly by materials available from excavations for appurtenant spillways, outlet works, and power plants. The magnitudes of these excavations for 32 major dams designed by the Bureau of Reclamation are listed with three examples of their influence on embankment design.

1208. Rivers Under Influence of Terrestrial Rotation, by Otakar W. Kabelac. (WW) The mathematical evaluation of forces involved in the formation of river beds, according to the Law of Baer, is outlined. The mathematics of this paper is based on the principle of dynamics regulating the Coriolis Force, which is created by a mass moving in a rotating system. In the given case the mass is the mass of river flow moving on the surface of the rotating earth.

1209. Flood Control Plan for the Ohio River Basin, by Bruce R. Gilcrest, Emil P. Schuleen, and Edgar W. Landenberger. (WW) The present flood control project for the Ohio River Basin is described. The hydraulic and economic effectiveness of the completed portion of the project is presented. The need of continuing the work is discussed in view of the expanding economy of the basin.

1210. Laboratory Study of Wind Tides in Shallow Water, by O. J. Sibul and J. W. Johnson. (WW) Wind tides and wave conditions in shallow water were studied in a laboratory channel with wind velocity and bottom roughness being the principal variables. Water-surface profiles and data on the relationship between bottom and surface shear forces are presented.

1211. The Littoral Drift Problem at Shoreline Harbors, by J. W. Johnson. (WW) A harbor which fronts directly on an open shoreline and has a relatively small flow is defined as a shoreline harbor. For such harbors, where a littoral drift occurs along the shoreline, certain design, construction, and maintenance problems exist. This paper summarizes some of these basic considerations and presents a few case histories of typical shoreline harbors.

1212. Plate Buckling in the Strain-Hardening Range, by Geerhard Haaijer. (EM) Stress-strain relations for the strain-hardening range of structural steel are derived and applied to the plate buckling problem. The corresponding orthotropic behavior of steel is described by effective moduli, taking into account the influence of initial imperfections. Agreement between theoretical and experimental results justifies such an approach.

1213. Inelastic Response of Columns to Dynamic Loadings, by B. J. Hartz and Ray W. Clough. (EM) A method is proposed for determining the response of pinned-end columns to compressive loadings of arbitrary time history when the deformations of the column extend into the inelastic range. Numerical methods are used to integrate the equations for the elastic and inelastic response. The results are compared to the experimentally determined response of an actual column.

1214. Some Contributions to the Wedge-Water Entry Problem, by Sidney F. Borg. (EM) The paper presents some of the results of a study of the wedge-water entry problem based upon a new formulation of the basic equations of hydrodynamics applicable to this problem. Exact and approximate solutions (and some experimental results) are given for various straight-sided and blunt-nosed wedges.

1215. Fly Ash Concrete for Shippingport Atomic Power Station, by Robert J. McAllister. (EM) About 15,000 cu yd of fly ash concrete using type IS Portland Blast Furnace slag cement have been placed at the Shippingport Atomic Power Station. This paper deals with the ways in which the solution of many problems was accomplished, with particular emphasis on the development of a mix designed to attain a compressive strength of 3,000 lb per sq in. at 28 days.

1216. Water-Hammer Design Criteria, by John Parmakian. (EM) A design criterion for including the effects of water hammer in turbine penstock and pump discharge line installations is outlined. Various possible conditions of operation are enumerated, and suitable factors of safety are assigned to each contingency. Typical examples are included.

1217. Arch Dams: Review of Experience, by Robert E. Glover. (PO) The review presents records of the performance of some of the older arch dams to learn how well they had served the purposes of their designers. The records are presented in tabular form, supplemented by notes and pictures.

1218. Sanitary Engineering Education: Its Evolution, by Harvey F. Ludwig, Edmund J. Laubusch, and Erman A. Pearson. (SA) Sanitary engineering education has been undergoing a steady evolution over the past 65 yr to meet the demands of a changing technology. The present trend is toward graduate level training with uniform standards of education becoming a necessity.

1219. Sanitary Engineering Education: General Requirements, by Daniel A. Okun. (SA) Sanitary engineers must be educated to meet modern challenges. The many areas of science preparation and the desirability of development through a major branch of engineering, preferably civil engineering, require that sanitary engineering education be on a graduate basis, with a faculty strong in the sciences. Sanitary engineers on undergraduate engineering faculties have an opportunity to recruit to the field.

1220. Sanitary Engineering Education: Needs in the Southeast, by John E. Kiker, Jr. (SA) The sanitary engineering needs have been very great in the southeastern section of the United States. In order to meet these needs there has been an increase in the sanitary engineering education in the colleges and universities in this area. With the increased education has come means of attracting young students through various financial methods of support while attending school.

1221. Sanitary Engineering Education: Industrial Hygiene Engineering, by Alvin F. Meyer, Jr. (SA) As a segment of sanitary engineering, industrial hygiene imposes certain education requirements which must be satisfied before the engineer is qualified to solve industrial health problems. The questions of where industrial hygiene education fits into the over-all sanitary engineering education and what is required are discussed.

1222. Sanitary Engineering Education: Air Pollution Engineering, by Harvey F. Ludwig and Frank A. Butrica. (SA) The increased importance of air pollution in modern technology is creating problems which must be solved. At the present time the sanitary engineering education falls short of preparing the engineers for solving air pollution problems. A new curriculum for specialists in air pollution is outlined.

1223. Sanitary Engineering Education: Industrial Wastes Engineering, by Ross E. McKinney. (SA) The current sanitary engineering education, with its undergraduate civil engineering and graduate sanitary engineering, fails to train engineers to solve industrial waste problems. The best background lies in chemical engineering or in the new biochemical engineering.

1224. Sanitary Engineering Education: ICA Assistance in Peru, by Marvin L. Granstrom. (SA) The United States, through the University of North Carolina School of Public Health and under the assistance of the International Cooperation Administration, has undertaken the task of assisting the Universidad Nacional de Ingenieria, Lima, Peru, in developing an adequate sanitary engineering program.

1225. Discussions of Proceedings Papers 959, 1089. (PO) Andre Coyne closure to 959. Robert C. Price and T. G. Swennes on 1086.

1226. Discussions of Proceedings Paper 867. (WW) E. D. Butcher, Bailey T. Bardeleben on 867. Willard P. McCrone closure to 867.

1227. Discussions of Proceedings Papers 885, 928, 1002, 1078, 1083, 1115, 1172. (SA) V. B. Lamoureux closure to 885. Corrections to 928. Gerald T. Orlob and Robert G. Butler closure to 1002. Ralph Porges on 1078. Claes N. H. Fischerstrom on 1083. Thomas R. Camp on 1115. Corrections to 1172.

1228. Discussions of Proceedings Papers 934, 940, 1079, 1080, 1081, 1145, 1160. (SM) Charles R. Foster and W. J. Turnbull closure to 934. James F. McNulty closure to 940. Yoshichika Nishida, S. F. Gisienski on 1079. John A. Focht, Jr. on 1080. Ralph F. Reuss; R. B. Peck, M. T. Davisson, and Vello Hansen; Raymond Lundgren; Lymon C. Reese; E. A. Ripperger; Hudson Matlock on 1228. A. Warren Simonds on 1145. T. H. Wu on 1160.

1229. Discussions of Proceedings Papers 945, 1032. (EM) H. A. Einstein and Huon Li closure to 945. Corrections to 1032. William Zuk closure to 1032.

1230. Discussions of Proceedings Papers 668, 953, 1006, 1038, 1077, 1082, 1114, 1157. (HY) Norman H. Brooks closure to 668. Enos J. Carlson and Carl R. Miller closure to 953. L. J. Tison on 1006. Francis F. Escoffier closure to 1006. M. B. McPherson and R. G. Dittig; F. Paderi on 1038. Ven Te Chow on 1077. Mikhail S. Hanna; M. Gamal Mostafa; Y. M. Simaika and N. Boulos on 1082. Ven Te Chow on 1114. Corrections to 1157.

May

1231. Column Design Simplified, by Richard H. J. Pian. (ST) A simple general approach to the analysis of columns within elastic range is developed. The application to practical design problems is simplified by introducing a four-quadrant graph, which may be used for column design having different degrees of imperfections, different end connections, and materials with different yielding stresses.

1232. Inelastic Behavior of Impulsively Loaded Beams, by M. J. Greaves and F. T. Mavis. (ST) This paper presents useful methods of solving design problems involving the motion of a beam where (*a*) the applied load is impulsive and (*b*) the distortions are inelastic. A nondimensional characteristic number is proposed to order and classify many forms of impact and impulsive loads on a single basis.

1233. Analysis of Multi-Story Building Frames, by T. F. Hickerson. (ST) The analysis of a multistory building frame is presented based on the slope-deflection theorem. Applying statical equilibrium at each joint and in every story of the frame gives as many equations as unknowns, but solving these equations is prohibitive. Hence, approximate methods converging rapidly toward accuracy are desirable.

1234. Beam Deflection in Bridges Designed for Continuity, by Guillermo Villena. (ST) This paper presents a formula for deflection at any point for continuous beam bridges where the beams are of constant moment of inertia and constant modulus of elasticity. The formula applies also to variable moment of inertia and to any number of continuous spans.

1235. The Relationship of Irrigation to Public Health, by Lloyd E. Myers, Jr. (IR) Serious, mosquito-caused public health problems exist in many irrigated areas of the United States. They are primarily the result of faulty irrigation structures and practices which also cause water waste, damaged soils, and reduced crop production.

1236. Pumping Requirements for Leveed Agriculture Areas, by H. W. Adams. (IR) A method is presented for determining the optimum pumping capacity requirements for stations serving leveed agriculture areas. This method takes into consideration the basic hydrologic and economic factors. An economic evaluation is presented, based on the unit costs of pumping to reduce the depth and extent of flooding and to reduce the duration of flooding.

1237. Characteristics of New Type Cargo Ships, by Douglas C. MacMillan. (WW) This paper examines the design characteristics and functional problems of the roll-on, roll-off type of ship and of certain lift-on, lift-off types having similar basic features.

1238. Hurricane Design Wave Practices, by Charles L. Bretschneider. (WW) Methods are presented for allowing a better estimate to be made of obtaining hurricane design waves for offshore and coastal structures. Two important concepts are described, which allow the hurricane design wave and its recurrence interval to be obtained reliably: The "Energy Index" to obtain the design hurricane for deep-water wave conditions, and techniques for computing wind waves over a shallow bottom taking bottom friction into account.

1239. Modern Facilities for Ohio River Navigation, by James W. Bruce, Dwight W. Keller, and James A. Neill. (WW) Because of physical deterioration, obsolescence, and increasing traffic, it is necessary to modernize and replace navigation facilities on the Ohio River and certain major tributaries. This paper presents the general requirements and criteria establishing the characteristics of replacement facilities now being constructed or in the planning stage.

1240. Mississippi River-Gulf Outlet, by William H. Lewis and L. C. Brune. (WW) A resume is given of the history and background of a project of vital importance to the City of New Orleans (La.) and the Mississippi Valley—the construction of the Mississippi River-Gulf Outlet. The development and costs of the project are examined, together with the technical and engineering features. However, the content of the paper is essentially nontechnical, due to the present state of the planning.

1241. Mobile Harbor and Ship Channel, by Harold E. Bisbort. (WW) The Port of Mobile (Ala.) is located at the head of Mobile Bay, an arm of the Gulf of Mexico having natural depths inadequate for deep-draft vessels. This paper describes the gradual improvement of the channel through the years and traces the history of its effect on commercial and industrial activity.

1242. Mississippi River—Baton Rouge to the Gulf of Mexico, by Otis M. Jernigan. (WW) The navigation project for deep-draft shipping on the lower Mississippi River extends 250 miles upstream from the Gulf of Mexico. The effect of the major features of the project on commerce and industry are described and related to the proposed New Orleans (La.) tidewater channel and other waterway improvements.

1243. Flood Control for the Mississippi-Yazoo Delta, by C. K. Little. (WW) The Mississippi-Yazoo Delta is protected from flooding by the Mississippi River by levees along the east bank. However, large areas are subject to flooding from interior drainage, runoff, and backwater from the river. The Corps of Engineers (United States Department of the Army) is constructing flood-control works for the area.

1244. The Constructor's Problems, by Charles E. McKee. (HW) This paper reviews the roles of the highway administrator, the engineer, and the contractor in an expanded highway program. Problems of management are discussed, as well as the manner in which many of these problems can be minimized.

1245. Problems of Engineering Management, by Edward J. Donnelly. (HW) Engineering management comprises the direction, supervision, and coordination of the design and construction phases of a highway program and will be a major factor in the successful completion of the national highway program.

1246. Operating Problems of Maintaining Uninterrupted Use, by H. George Yeager. (HW) The "Interstate System" of limited access highways will provide motorists with the most modern routes that can be devised. Unless maintenance and maintenance procedures are revised and amplified to provide uninterrupted use, freedom of movement and carrying capacity provided by construction will be greatly restricted.

1247. Legal Problems Relating to Construction of Expressways, by Joseph D. Buscher. (HW) This paper presents the more important legal problems faced by highway departments and engineers in constructing expressways. Treated at some length are right-of-way acquisition and condemnation for future construction, "prior entry for construction purposes," and the right to exclude abutting property owners from access.

1248. Shoreside Facilities for Special Purpose Ships, by Howard J. Marsden. (WW) A brief history is given together with the current situation regarding special purpose vessel operations and proposed ship construction program, as well as the layout, general design criteria, and technical analyses of roll-on, roll-off, lift-on, lift-off containers and conveyor terminals for trailerships, trainships, and containerships.

1249. Operation Problems on Controlled Access, by Charles M. Noble. (HW) The paper emphasizes the advantages of the controlled access highway and outlines the facilities necessary to provide for the comfort and safety of the public.

1250. The Use of Technicians in Highway Engineering, by Scott H. Lathrop and Francis J. Farias. (HW) The importance of making the best possible use of nonengineers and engineering technicians is stressed as being the only solution to the problem of the continuing shortage of engineering graduates.

1251. Evolution of the Mississippi Valley Flood Control Plan, by John R. Hardin. (WW) The development of the lower Mississippi Valley flood control plan is traced from its beginning to the comprehensive plan now being conducted by the Corps of Engineers (United States Department of the Army).

1252. Navigable Waterways and Industrial Development, by Dewitt L. Pyburn. (WW) Effects of navigable waterways on industrial development in the South are described together with the effects of the availability of water and flood protection. Parallel developments of navigable waterways and industrial concentrations are traced for the Mississippi River and Warrior-Tombigbee River and for the Gulf Intracoastal Waterway.

1253. Irrigation-Drainage-Climatology for Flat Humid Land, by Harry Rubey. (IR) Irrigation, drainage, and climatology are combined under professional corporate management for an engineer-agronomist-climatologist type to increase profits greatly on large holdings of flat humid lands.

1254. The Behavior of One-Story Reinforced Concrete Shear Walls, by Jack R. Benjamin and Harry A. Williams. (ST) Results are given of an investigation of one-story plain and reinforced concrete shear walls subject to shear forces applied in the plane of the wall. Panel proportions and reinforcing and column proportions and reinforcing were investigated. Some approximnte relationships are suggested for predicting the load-deflection curves for these walls.

1255. Lateral Load Distribution Test on I-Beam Bridge, by Ardis White and William B. Purnell. (ST) This paper presents procedures, results, and conclusions from a strain gage test performed on a highway bridge to determine (1) the degree of composite action and (2) effectiveness of the diaphragms in lateral distribution of loads.

1256. Manpower Problems in the Highway Program, by C. E. Fritts. (HW) A program of action is necessary to bring more students into the civil engineering field to help the better placement of men and to place salaries on a competitive basis. Positive action must also be taken on incentives such as stability of employment and advancement, retirement benefits, working conditions, health and welfare, and professional recognition.

1257. Discussions of Proceedings Papers 884, 961, 1103, 1104, 1105. (IR) R. D. Goodrich closure to 884. N. B. Bennett, Jr. closure to 961. C. L. McGuiness, J. G. Ferris, Meyer Kramsky on 1103. Carl Rohwer, Kenneth M. Turner, Irvin M. Ingerson on 1104. M. A. Selim on 1105.

1258. Discussions of Proceedings Paper 1090. (HW) A. H. Brownfield, J. J. Naughton, Angel Piccio Villasor, Jr. on 1090.

1259. Discussions of Proceedings Papers 851, 973, 1019, 1020, 1022, 1096, 1097, 1101, 1106, 1108. (ST) Corrections to closure to 851. Corrections to 973. Roy C. Edgerton and Gordon W. Beecroft closure to 973. Milton Brumer and C. W. Hanson closure to 1019. M. W. Huggins and W. L. Lin closure to 1020. Phil M. Ferguson closure to 1022. Arturo J. Bignoli on 1096. Harold G. Lorsch on 1097. A. F. Foerster on 1101. I-Chen Chang on 1106. Corrections to 1108.

June

1260. The Efficacy of Flow Sills Under Drowned Hydraulic Jumps, by Ahmed Shukry. (HY) Velocity-measurement tests were performed on a scale model with a fixed bed representing the Edfina Barrage on the Nile River (Egypt). Effects of type and location of the floor sills on the erosive power of water were investigated under the conditions of deeply drowned jumps.

1261. Losses Due to Ice Storage in Heart River, North Dakota, by H. M. Erskine. (HY) Winter flows in the lower reaches of the Heart River (North Dakota) have been regulated by Heart Butte Dam since 1949. Flow records indicate water losses due to storage because ice is low for smaller discharges, particularly if rate of release decreases during the winter; however, the opposite is true for higher flows and increasing rates of release.

1262. Attenuation of Solitary Waves on a Smooth Bed, by Yoshiaki Iwasa. (HY) Attenuation of solitary waves by viscous shear within the laminar boundary layer on a horizontal smooth bed is considered, based on the finite amplitude theory of solitary waves. The behavior of attenuation processes is expressed in terms of the usual form, as was done by Messrs. Keulegan and Ippen, and is compared to experimental data of Messrs. Russell and Ippen.

1263. The Role of Sedimentation in Watersheds, by Fred H. Larson and G. Robert Hall. (HY) Federal participation in watershed programs depends on the premise that benefits must exceed the costs of any proposal. Because program proposals may have widely divergent effects on sediment and floodwater damages, separate appraisal systems must be devised for floodwater and sedimentation damages. The approach to sediment problems being undertaken by the United States Department of Agriculture is outlined.

1264. Stilling Basin Experiences of the Corps of Engineers, by R. H. Berryhill. (HY) This paper describes experiences of the Corps of Engineers (United States Department of the Army) in the design, operation, and maintenance of stilling basins below spillways and outlet works of reservoir projects. Several model and prototype correlations and some conclusions which may be drawn from the experience described are also included.

1265. Recirculation of Cooling Water in Rivers and Canals, by Geza L. Bata. (HY) Cooling water discharged from steam plants tends to form a warm, wedge-like stratum which extends upstream from the outlet on top of the ambient water. Both the form of the stratum and the resulting amount of recirculation are investigated analytically and experimentally, and design criteria are presented.

1266. A Study of Bucket-Type Energy Dissipator Characteristics, by M. B. McPherson and M. H. Karr. (HY) A laboratory study covering a wide range of variables, but limited to a 45° exit angle and approach slopes of 1 on 1 and 1 on 2, is described. A comparison is made with tailwater requirements for a hydraulic jump on a horizontal floor. Required bucket radii for various service conditions are specified with the objective of obtaining design criteria.

1267. Arch Dams: Stress Studies for Ross and Diablo Dams, by J. T. Richardson and O. J. Olsen. (PO) Representative results are presented of a long-time study of stress from strain meters at Ross Dam (Washington). Included is an outline of the method used to derive stress from embedded strain meters together with the preliminary results obtained from a stress study on Diablo Dam (Washington) by strain relief measurements.

1268. Engineering for Expanding Foreign Power Companies, by John F. Pett. (PO) Special problems are outlined that have been experienced by the utilities in the rapid expansion of electric power developments in Latin America. Illustrations are drawn from specific plants as well as from the background and planning for the construction of the Peixoto Plant.

1269. SED Research Report No. 12: Biological Oxidation of Alkaline Wastes, by Sanitary Engineering Research Committee, Industrial Wastes Section. (SA) Biological action does occur at pH-values of from 9 to 11. Less oxidation results at the high pH-values, but

the capital and operating costs involved with neutralization are eliminated. Results include experiments with paper mill, textile, synthetic, domestic, and mixed wastes.

1270. SED Research Report No. 13: Milk and Food Problems in Civil Defense, by Sanitary Engineering Research Committee, Public Health Engineering Section. (SA) Milk and food resources and water supplies, which are of vital concern in emergency conditions, are subject to hazards caused by radioactivity and sabotage. Food safety and salvage problems are reviewed.

1271. Importance of Ground Water in Our National Economy, by A. C. Fiedler. (SA) Typical ground-water problems in six areas of the United States are reviewed, and it is concluded that their solution must rest on adequate knowledge of the character and capacity of the ground-water reservoirs involved and on comprehensive planning for the best use of the available ground-water supply.

1272. Surface Water Resources, by J. V. B. Wells. (SA) Over a period of years the average annual runoff for any stream tends to conform to a characteristic geographic pattern, but year-to-year runoff varies widely. Annual runoff in the United States during the period, 1953-1956, is analyzed briefly. The expansion of irrigation in the eastern states is examined, and the importance of hydrologic analyses and legislation to meet problems arising from competition with other uses is emphasized.

1273. Hydraulic Model Study of Hyperion Sewer Interchange, by Alfred C. Ingersoll and Hajime Tanaka. (SA) A 1:20 scale model of the interchange structure at the junction of two outfall sewers approaching the Hyperion Sewage Treatment Plant was tested, in accordance with the Froude Law, to determine the effects of the various flow distributions among the two influent sewers and channels leading to the new and existing headworks.

1274. Flow of Concentrated Raw Sewage Sludge in Pipes, by Sterling G. Brisbin. (SA) The problem of pumping concentrated sewage sludges is examined with data for solids concentrations of up to 16%. Friction losses with heavy solids can be computed with the Hazen-Williams formula using C-values that are from 60% to 75% of those for water.

1275. Recent Developments in the Treatment of Atomic Wastes, by Conrad F. Straub. (SA) Handling process wastes from the atomic energy industry poses some unusual waste treatment problems. Developments for handling, treatment, and disposal of radioactive liquid wastes are discussed.

1276. An Analysis of Sand Filtration, by W. A. Hall. (SA) An analytical treatment is presented of the mechanism of the filtering action of sand filters, and equations are derived for the distribution of sediment as a function of filter distance.

1277. Measurement of Sedimentation in TVA Reservoirs, by E. H. McCain. (HY) Sediment investigations in the Tennessee Valley are so numerous that special consideration should be given to the equipment used in making these investigations. Equipment assembled or developed by the TVA, which has materially increased the accuracy and efficiency of field work, is described.

1278. Automatic VHF Radio Telemetering of Hydrologic Data, by James A. Dale. (HY) The basic operation, equipment, and costs are described for a completely automatic radio gage system for obtaining rainfall amounts and stream-level data. The TVA system used for 40 stations operates on the 169-to-172 megacycle band allocated for hydrologic-data transmission.

1279. High-Pressure Steam Main Under New York City Streets, by James C. Fisher. (PL) This paper describes the design and construction of a 24-in., high-pressure steam main in New York (N.Y.). Problems of selecting a lane through congested traffic and subsurface-structure areas are described, and a description is included of special anchorage details and construction difficulties in reclaimed swamp land.

1280. Secondary Stresses in Large-Diameter Pipelines, by G. M. McClure. (PL) Predominant secondary stresses in line pipe during shipment and construction and operation of a line are examined, and examples of their magnitude are given.

1281. Pipeline River Crossings, by Leo M. Odom. (PL) The forces to be considered and the necessary investigations for the design of a river crossing of a large steel welded pipeline are outlined. The factors involved in selecting the site, determining the working season, and constructing an underwater crossing are examined.

1282. Salaries of Local Environmental Health Personnel in 1956, Report of the Committee on Salaries, Conference of Municipal Public Health Engineers. (SA) This report covers the salary status of the environmental health personnel in 1956. Changes in income status over the past five years are also given.

1283. Discussion of Proceedings Papers 1082, 1113, 1166, 1200. (HY) Harold Edwin Hurst on 1082. Louis W. Wolf on 1113. H. Alden Foster on 1166. Gordon R. Williams on 1200.

1284. Some Problems of a Penstock Builder, by John N. Pirok. (PO) Problems encountered in the building of a penstock are described—for example, those connected with engineering personnel, procurement, fabrication, transportation, erection, welding, and testing—with particular emphasis placed on problems of engineering and erection.

1285. Penstock Design and Construction, by G. R. Latham. (PO) General design features and construction procedures for various penstock installations are described and illustrated. Penstocks designed and constructed in accordance with the practice outlined result in adequate installations at reasonable cost.

1286. Arch Dams: Economy of Concrete Dams, by Louis G. Puls. (PO) Safety and economy are considered in the final selection of type for large concrete dams. This selection is further influenced by the arrangement of dam and appurtenant works. Pertinent unit cost data from sources in various countries are included.

1287. Discussion of Proceedings Papers 991 and 1042. (PO) A. Warren Simonds closure to 991. O. C. Zienkiewicz closure to 1042. Corrections to 1042.

1288. Discussion of Proceedings Paper 1115. (SA) Alex N. Diachishin, A. Pasveer, M. C. Rand on 1115.

July

1289. Mississippi Valley Geology—Its Engineering Significance, by C. R. Kolb and W. G. Shockley. (SM) The increasing importance of geologic information to the design of engineering structures in the lower Mississippi River valley is pointed out. The various environments of alluvial deposition and the resulting soil formations are discussed, especially with relation to engineering problems associated with them.

1290. Deflections of Structures in the Inelastic Range, by Kurt H. Gerstle. (EM) An approach to the problem of finding deflections of structures of perfectly plastic material in the inelastic range is developed. Charts relating loads and deformations of rectangular beams are furnished and may be used to analyze indeterminate structures composed of members of such cross sections in the inelastic range.

1291. Lateral Buckling of I-Beams Subjected to Unequal End Moments, by J. W. Clark, Jr. and J. R. Jombock, Jr. (EM) An experimental investigation into elastic and inelastic lateral buckling of aluminum alloy I-beams subjected to unequal end moments is reported. An approximate method is presented for determining the inelastic buckling strength of I-beams with this type of loading. Suggestions are made by which nonuniform bending could be handled more accurately in present design specifications.

1292. The Lateral Rigidity of Suspension Bridges, by I. K. Silverman. (EM) The behavior of a suspended structure under lateral loads is shown to depend on the values of three dimensionless parameters. The spring constant for small vibrations in the horizontal plane is also derived.

1293. Buckling of Plates Under Non-Homogeneous Stress, by P. P. Bijlaard. (EM) Plastic buckling stresses are calculated for long clamped plates, clamped flanges, and hinged flanges, all subjected to longitudinal bending or eccentric compression in their plane. Simple design formulas and graphs are presented for the plastic reduction factor to be applied to the associated elastic cases.

1294. Location Needs to Get Full Benefits from Freeways, by R. N. Grunow. (HW) It is shown that freeways should be located to best serve traffic demands. General locations can be determined by the techniques of origin-destination studies.

1295. Freeway Benefits, by Terry J. Owens. (HW) This paper demonstrates that from every angle of measurement freeways have benefits which justify their construction. Fatality rates are only half and accident rates only a fifth of those on important surface arteries. Time and dollar savings are generally substantial on freeways. It is also shown that freeways increase property value and stimulate residential and industrial development.

1296. The Planning Role in Pittsburgh's Penn-Lincoln Parkway, by William R. B. Froehlich. (HW) This paper outlines the role of city planners and planning agencies in the development of the new Pittsburgh Renaissance. It describes in detail the background and planning of the Penn-Lincoln Parkway, Pittsburgh's east-west expressway.

1297. Tests to Evaluate Concrete Pavement Subbases, by L. D. Childs, B. E. Colley, and J. W. Kapernick. (HW) It is shown that concrete pavement slabs on dense graded granular subbases developed smaller strains, deflections, and subgrade pressures under test loads than slabs directly on clay subgrades. Thin subbases, 6 in. or less, reduced deflections more effectively per unit thickness than thicker subbases.

1298. Highway Planning, by E. H. Holmes and J. T. Lynch. (HW) Highway planning has been carried out jointly by the Bureau of Public Roads and the State Highway departments throughout the past twenty years. Facts affecting state and federal legislation have been assembled. Methods must be perfected for keeping the needs studies current and projecting them into the future.

1299. Dewatering Miami's Biscayne Aquifer, by Byron J. Prugh. (SM) This paper describes the use of wellpoints in dewatering a major excavation penetrating deep into the Biscayne Aquifer through the Miami oolite and the soils encountered.

1300. Horizontal Drains on California Highways, by T. W. Smith and G. V. Stafford. (SM) A discussion is presented of changes in methods of installation, development of equipment, and engineering aspects of horizontal drains on California highways in the light of sixteen years of experience and thousands of feet of drains installed.

1301. A Review of the Theories for Sand Drains, by F. E. Richart, Jr. (SM) This paper presents available theories for sand drains with regard to assumptions and limitations. Effectiveness of small-diameter "ideal" wells is illustrated, and use of numerical procedures for consolidation problems is also discussed.

1302. Vehicle Loads and Highway Bridge Design, by Stewart Mitchell and Gerald F. Berrmann. (ST) This paper analyzes inconsistencies which appear when highway bridges of different types are rated for overload capacity. Capacities in relation to maximum live loads and frequency of heavy load applications in actual service are considered, and recommendations concerning choice of design loads are offered.

1303. Distribution of Loads on Bridge Decks, by A. M. Lount. (ST) This paper examines recent developments in computation techniques as applied to determination of load distribution between longitudinal members of bridges. The action of diaphragms and their beneficial effects and economy are emphasized.

1304. Fatigue Resistance of Prestressed Concrete Beams in Bending, by C. E. Ekberg, R. E. Walther, and R. G. Slutter. (ST) A method is presented to predict fatigue strength of prestressed concrete based on the failure envelope of materials involved. A discussion of factors influencing fatigue strength, such as percentage of steel, level of prestress, and ratio of dead to live load, is also included. Recommendations are given on safety factors for prestressed concrete under fatigue loading.

1305. Research and New Developments in Photogrammetry, by C. L. Miller. (SU) Significant advances in photogrammetry during the past five years and current research programs of importance to civil engineers are discussed in this paper. New advances toward goals of higher precision, time and cost reductions, and new applications are outlined. The M. I. T. research program on photogrammetry and highway engineering is summarized.

1306. Progress Report of the Committee on Highway and Bridge Surveys, Surveying and Mapping Division: Foreward to Manual on Highway and Bridge Surveys and Chapter I—State Plane Coordinates. (ST) This paper which is the first in a series that will comprise a new society manual on Highway and Bridge Surveys shows the importance of basing highway surveys on state plane coordinate systems.

1307. New Highways and Photogrammetry, by John G. Ladd. (SU) This article discusses some of the specific advantages of the use of photogrammetric consulting engineers in initial preparation for highway work.

1308. Application of Digital Computers to Bridge Design, by Charles F. Scheffey. (ST) This paper presents a discussion of characteristics of digital computers and the steps necessary to apply them to problems in bridge analysis and design. Recent advances in coding techniques and the potentialities of the computer in more refined analysis and optimization of design are indicated.

1309. Determination of the 0.02 Mm Fraction in Granular Soils, by R. W. Johnson. (SM) This paper describes the method of using statistical analysis to determine the constant representing the ratio of the percent of material finer than .02 mm to the percent passing the No. 200 sieve. Results of tests on twenty-four granular soils are given, together with values for the constant.

1310. Discussions of Proceedings Paper 1064, 1117. (SU) Staley W. Mims, Virgil A. Walston on 1064. Corrections to 1117.

1311. Discussions of Proceedings Papers 1030, 1031, 1138, 1141, 1157. (EM) Peter Price closure to 1030. Corrections to 1031. Lorenz G. Straub, Edward Silberman, Herbert C. Nelson closure to 1031. T. Blench on 1138. T. Au on 1141. John A. Hribar on 1157.

1312. Aluminum Applications in Highway Bridges, by J. M. Pickett. (ST) This paper outlines aluminum alloys used for highway bridges, and reviews the aluminum accessories which are becoming standard usage on conventional bridges.

1313. Selection of the Cross Section for a Composite T-Beam, by R. S. Fountain and I. M. Viest. (ST) The paper discusses a rapid method of selection based on approximate formulas for the section properties.

1314. Highway Bridge Live Loads Based on Laws of Chance, by Henson K. Stephenson. (ST) A new method based on elementary probability theory is presented for estimating live load frequencies on highway bridges. The method will provide a simple mathematical basis for estimating the number of various intensities of stress repetitions produced during the useful life of any given bridge.

1315. Load Factors for Prestressed Concrete Bridges, by T. Y. Lin. (ST) The use of load factors in ultimate design for prestressed concrete bridges is compared to the elastic theory and allowable stress method. Variables affecting the load factor of bridge sections are analyzed, indicating its wide divergence when designed on the basis of no tension in concrete.

1316. Synopsis of First Progress Report of Committee on Factors of Safety, by Oliver G. Julian. (ST) This paper gives definitions, statistical data regarding variations in physical properties of steel and concrete, and tables for correlating factors of safety and probabilities of failure.

1317. Testing Post-Tensioned Slab and Beam without Grouting, by Zachary Sherman. (ST) Two industrial building post-tensioned members were tested in laboratories at the University of Mississippi, at University, in November, 1955. Load versus deflection curves were plotted. Stress diagrams were computed and factors of safety were also determined.

1318. Vibration Susceptibilities of Various Highway Bridge Types, by LeRoy Theodore Oehler. (ST) This paper reports results of deflection and vibration measurements on thirty-four spans of fifteen bridges including simple, continuous, and cantilever type spans.

1319. Discussions of Proceedings Papers 1025, 1026, 1080, 1143, 1145, 1159, 1160, 1161, 1289. (SM) W. A. Clevenger closure to 1025. Nai-Chen Yang closure to 1026. W. G. Shockley and T. B. Goode closure to 1080. Judson P. Elston, Howard P. Hoffman on 1143. Judson P. Elston, Glebe A. Kravetz on 1145. John W. Guinnee and Charles E. Thomas on 1159. Louis P. Menard on 1160. Alfred A. Seymour-Jones, Byron J. Prugh on 1161. Shu-T'Ien Li on 1289.

1320. Applications of AASHO Specifications to Bridge Design, by Eric L. Erickson and Neil Van Eenam. (ST) This paper explains the application of the specifications of the American Association of State Highway Officials (AASHO), paying special attention to the history and development of the various provisions. A section is included covering their application to bridges on the National System of Interstate and Defense Highways. An extensive bibliography is added for reference.

1321. Backfill Guide, by R. B. Peck and H. O. Ireland. (ST) This paper demonstrates the importance of the backfill, points out reasons for specified backfilling procedures, and shows various construction practices that should be avoided.

1322. Dispersion of Longitudinal Waves, by E. Volterra. (EM) Dispersion of longitudinal waves in elastic rods of rectangular cross section is discussed by applying the method of internal constraints. Results given by this theory are compared with those given by other approximate engineering theories, and, in the case of two-dimensional elasticity, with the exact theories given by Lord Rayleigh and Lamb.

1323. Cold Regions Research by the U. S. Corps of Engineers, by Robert R. Philippe. (AT) This paper outlines the Corps of Engineers' (United States Department of the Army) research and development program in the Arctic. Work in progress in Greenland is set forth in detail. Air, surface, and subsurface transport problems are discussed against a background of available materials, power sources, and weather.

1324. Testing of a Compacted Snow Runway, by James A. Bender. (AT) This paper consists of a comprehensive report on the field testing of a snow runway built on the Greenland ice cap by the Corps of Engineers. Test methods and results obtained are set forth in detail.

1325. Aircraft Operations on Floating Ice Sheets, by S. Russell Stearns. (AT) This paper outlines fundamental relations of load and support of a floating ice sheet and extends these concepts to problems of aircraft operations on this medium. The failure mechanism of ice sheets is explained, and limiting load conditions for various failure-stages are indicated. Ice-survey procedure and the effects of variable factors on load capability are carefully set forth.

1326. Airfields on Permafrost, by Kenneth A. Linell. (AT) This paper outlines special problems of constructing airfield pavements on permafrost foundations. Particular attention is devoted to problems of construction in areas of discontinuous permafrost. Importance of non-frost-susceptibility soils is shown, and means of combating degradation of pavements are carefully explained.

1327. White-Out, A Hazard to Arctic Flying, by R. W. Gerdel and M. Diamond. (AT) The studies on Arctic white-out reported in this paper were conducted at a field research station located on the Greenland ice cap. The paper discusses five white-out phenomena, analyzes the possibility of forecasting these phenomena, and suggests methods of dispersal.

August

1330. Hurricane Effect on Sea Level at Charleston, by Bernard D. Zetler. (HY) Tropical cyclones from 1922 to 1955 have been classified according to the orientation of their tracks with respect to Charleston Harbor. Theoretically, the displacement of sea level depends on this orientation; the tabulated displacements caused by tropical cyclones during 34 years of tide observations bear out the relationships.

1331. Systematic Changes in the Beds of Alluvial Rivers, by Walter C. Carey and M. Dean Keller. (HY) This paper describes the sand wave formations present in alluvial rivers and discusses their variation with respect to river stages. The related rise and fall of crossings is also discussed. The illustrations are prepared from fathometer surveys and show the changes in the sand waves due to changes in stage.

1332. Synthetic Storm Pattern for Drainage Design, by Clint J. Keifer and Henry Hsien Chu. (HY) A method for deriving a synthetic storm pattern from local rainfall records is presented. The result is a single storm pattern encompassing the effects of storms of different durations. The storm pattern is a prerequisite of the hydrograph method for attacking the drainage design problem.

1333. Sanitary Sewage Disposal in Subdivisions, by Paul W. Richards. (SA) One of the major sanitary problems lies in the satisfactory disposal of sanitary sewage from subdivisions. A discussion of the problem and some efforts directed towards its solution are given.

1334. Adsorption and Assimilation in Activated Sludge, by Charles Smallwood. (SA) Activated sludge is widely used for the stabilization of sewage and industrial wastes. Evidence is presented to show that the soluble organic matter is removed from solution by assimilation while suspended and colloidal organic matter is removed by adsorption.

1335. Direct Recharge of Ground Water with Sewage Effluents, by R. B. Krone, P. H. McGauhey, and H. B. Gotaas. (SA) The paper presents results of a three-year study in which sewage effluents were injected directly into a confined aquifer and the travel of pollution observed in twenty-three surrounding sampling wells. The technical feasibility and public health safety of direct recharge of ground waters were established by the field scale experiments described.

1336. Trickling Filters Successfully Treat Milk Wastes, by Paul E. Morgan and E. Robert Baumann. (SA) More data is needed by the milk industry regarding successful methods of waste treatment. This paper discusses the volume and strength of wastes discharged, and unit loadings and efficiencies at two waste treatment plants that have proved successful.

1337. Sewage Treatment by Raw Sewage Stabilization Ponds, by W. W. Towne and W. H. Davis. (SA) Data from studies carried out by the Texas State Department of Health and the U. S. Public Health Service in cooperation with North and South Dakota are discussed in this paper. Factors affecting the process of purification, and design of stabilization ponds are also considered.

1338. Public Health Service, Stream Pollution Abatement Program, by Lewis A. Young. (SA) The paper discusses reasons why engineers should be interested in stream pollution abatement. The new Federal Water Pollution Control Law is considered, as well as the importance of protecting our water resources.

1339. The Variable-Angle Launcher: A Naval Ordnance Testing Facility, by John L. Cox. (CO) A unique, high-speed, water-entry, missile-testing facility involving unusual design and construction is operated at Morris Dam in Southern California by the Naval Ordnance Test Station. This paper is the first of five describing general features, concrete

structures and foundations, steel structures, mechanical-electrical equipment and construction.

1340. Variable-Angle Launcher: Concrete Structures and Foundation Treatment, by James H. Jennison. (CO) This second paper on a water-entry, missile-testing facility describes the pyramid-shaped concrete structure which carries heavy moving loads and large recoil forces. The foundation on a steep slope was stabilized by pressure-grouting the numerous fissures in the rock. High-density concrete was used in a 600-ton counterweight car designed as a composite beam.

1341. Variable-Angle Launcher: Steel Construction, by N. D. Whitman, Jr. (CO) This third paper describes the design features of the moveable all-welded 300-ft launching bridge with its supporting 95-ft bridge and related steel structures. The application of welded design to heavy structural fabrication is discussed and illustrated.

1342. Variable-Angle Launcher: Mechanical and Electrical Features, by Francis L. Carlisle. (CO) This fourth paper in a series on a facility for studying high-speed water-entry of aircraft-launched torpedoes presents problems encountered in the design of machinery, electrical installations and instrumentation. Many unusual designs were required, including a high-pressure quick-acting air valve and tuned-mass vibration dampers for a large compressor.

1343. Variable-Angle Launcher: Construction, by Arthur C. Bravo. (CO) This last paper of the series describes the problems encountered in the construction of the Variable-Angle Launcher. Methods used in welding large structures, in transporting the 300-ft all-welded bridge and in guniting a slab on a 30 deg slope are illustrated, as well as the construction of a thick concrete slab on a 45 deg slope.

1344. Multi-Layer Penstocks and High Pressure Wyes, by Ewald Schmitz. (PO) Multi-layer penstock design and fabrication with field welding procedures is described with illustrations of installation in service. Construction features of several high pressure different wye designs are illustrated.

1345. Characteristics of Flow over Terminal Weirs and Sills, by P. K. Kandaswamy and Hunter Rouse. (HY) Generalized experimental results are presented to show the variation in both the discharge coefficient and the nappe profile for two-dimensional flow over a vertical sharp-crested weir at the end of a horizontal channel as the ratio of head to depth of flow changes continuously from zero to unity.

1346. Discussions of Proceedings Papers 997, 1184, 1216. (PO) M. Rocha, J. Laginha Serafim, A. F. da Silveira closure to 997. Paul H. Jeynes, Bert J. Blewitt, C. W. Bary and W. T. Brown on 1184. Carroll E. Withers on 1216.

1347. The 1957 ASCE Salary Survey, Donald H. Mattern, Chairman. (BD) The 1957 report of the Society's Committee on Salaries constitutes the fourth in the biennial series of salary surveys conducted by the Committee. Consonant with its purpose as stated in the By-Laws of the Society to ". . . collect, codify and prepare for distribution such data as may be calculated to be of value to employers of civil engineers and to civil engineering employees in connection with the proper classification of engineering positions and equitable compensation for such services," the Committee here presents the results of its 1957 survey.

1348. Discussions of Proceedings Papers 1009, 1034, 1162, 1165, 1166, 1167. (HY) Wen-Hsiung Li and Calvin C. Patterson closure to 1009. Emmett M. Laursen closure to 1034. Charles E. Behlke, Steponas Kolupaila on 1162. G. N. Alexander, Steponas Kolupaila on 1165. Corrections to 1166. M. A. Benson on 1166. Turgut Sarpkaya, G. Dugan

Johnson, Henry Voltmann, Ronald E. Nece on 1167.

1349. Discussions of Proceedings Papers 1178, 1179. (SA) Casimir A. Rogus on 1178. Judson P. Elston on 1179.

1350. Bibliography: Underground Hydroelectric Power Plants, by J. Barry Cooke and Arthur G. Strassburger. (PO) Underground hydroelectric plants are being adopted to an increasing extent throughout the world, except in the United States. The paper presents a review of existing general literature, a brief discussion, a list of the world's underground hydroelectric plants with some general data, and a chronological bibliography including brief resumes.

1351. Arch Dams: The Development of Model Researches in Italy, by Guido Oberti. (PO) Experimental researches on models in Italy have greatly contributed to the national design of arch dams. Actual possibilities of models based on the theory of similitude are discussed. Important cases of Italian arch dams studied by models are described and principal results obtained are reported.

September

1352. Irrigating in the Humid Areas, by E. A. Kimbrough, Jr. (IR) A comparison is made of the problems of irrigating in the humid area with those of the arid area. The paper considers the development of flow for irrigation involving drainage requirements, crop response, and labor requirements.

1353. Pin-Ended Gabled Frames, by James Chinn. (ST) This paper presents a method for solving pin-ended, one or two span, gabled frames by the method of consistent deformations. It utilizes moment distribution coefficients but does not require actual distribution of moments.

1354. Lateral Deflections and Stresses in Building Frames, by Robert E. McClellan. (ST) This paper demonstrates a method of analyzing multi-story rigid frames for deflections and stresses caused by lateral loads, based on structural properties of frame members. The sources and probable magnitude of error in calculated stress and deflection are discussed.

1355. Design of Multi-Level Guyed Towers: Wind Loading, by Edward Cohen and Henri Perrin. (ST) Methods are presented for computing wind loads on trussed frameworks as functions of wind velocity, solidity ratio, member shape, shielding, yaw and slenderness ratio. Shape factors for towers are proposed and compared with test data.

1356. Design of Multi-Level Guyed Towers: Structural Analysis, by Edward Cohen and Henri Perrin. (ST) Methods are presented for the structural analysis of multi-level guyed towers as continuous beam columns on yielding supports including effects of vertical guy reaction eccentricity, shaft distortion and torsion. Equations are given for analysis of the guys and determination of spring constants at the tower shaft.

1357. University Research in Structural Engineering, by Frank Baron. (ST) Different attitudes toward university research in structural engineering are considered. The writer sets forth his own views with particular reference to three categories of research. These categories are defined and consist of analytical, experimental, and design research. Specific examples of each kind of research are illustrated.

1358. Ultimate Strength of Short Struts, by Seng-Lip Lee and P. Ballesteros. (ST) The determination of the ultimate strength of short struts of any cross section subjected to the action of eccentric loads or pure nonsymmetrical bending is treated in this paper. The analysis is based upon an idealized stress-strain relationship assuming constant stress for strain beyond the yield point.

1359. Salt Balance in Ground Water Reservoir Operation, by David B. Willets and Charles A. McCullough. (IR) Operation of ground water reservoirs for seasonal and cyclic storage of water requires maintenance of suitable mineral quality of the ground water. Sources and disposal of salts, requirements for water, and deficiencies in present knowledge and data collection are considered. Illustrative computations for a hypothetical ground water basin are included.

1360. A Graphical Solution for Flow in Earth Channels, by Isidro D. Cariño. (IR) This paper presents a graphical solution utilizing Manning's Formula for the design of earth canals with trapezoidal cross sections. These graphs were prepared for a specific value of the coefficient of channel roughness closely approximating that for earth canals.

1361. Duration of Load and Fatigue in Wood Structures, Progress Report of a Sub-Committee of the Committee on Timber Construction of the Structural Division. (ST) This paper summarizes present knowledge of the effects of long-time loading and of fatigue on structural wood. A chart showing the relation of

safe working stress to duration of load is presented, and fatigue test data are reviewed. A section on the evaluation of old timbers in structures is included.

1362. Common Errors in Measurement of Irrigation Water, by Charles W. Thomas. (IR) The paper discusses errors which occur when dimensions, settings, flow patterns and other factors do not conform to accepted standards for water measurement devices. It is concluded that equipment designed to give accurate measurements may not do so unless due care is exercised in fabrication, installation, operation and maintenance.

1363. Drainage in the Mississippi River Valley, by Louis W. Herndon. (IR) This paper explains the coordination between the Soil Conservation Service and the Corps of Engineers, U. S. Dept. of the Army, in drainage activities in the alluvial valley of the Mississippi River. The relation of flood control and drainage is discussed and the different elements of complete surface drainage systems are described.

1364. Water Use in Industry, by Ray L. Derby. (IR) The paper presents various factors of use and demand for water on the water purveyor's system by industry. Factors of quantity and quality are considered. Potentialities and economics of re-use of water within an industry, and use of sewage and other municipal waste waters are discussed.

1365. Telemetering Hydrologic Data, by Francis P. Hanes. (WW) Automatic equipment is described to fulfill a requirement for optimized operation of reservoirs and other flood control structures by allowing rapid and unattended reporting of river levels and precipitation amounts from remote points. The emphasis is on design of telemetering devices and system engineering for VHF radio transmission of data.

1366. Cellular Cofferdams, and Docks, by E. M. Cummings. (WW) This paper covers a new theory of design for cellular cofferdams against failure by tilting, which is substantiated by results of model tests. The proposed theory is used to investigate the design of two actual structures, a cofferdam on rock, and a dock in sand. Several previously published theories are also discussed.

1367. Model Studies of Remedial Works for Niagara Falls, by A. P. Rollins, Jr., and G. B. Fenwick (WW) Model studies were made to determine the effects of increased diversions of Niagara waters for power and to design remedial works to enhance the scenic spectacle at Niagara Falls. The works developed consisted of a gated control structure in the river above the Cascades and combination excavations and fills at both flanks of the Horseshoe Falls. Subsequent field observations have verified model predictions.

1368. Offshore Breakwaters, by Richard Silvester. (WW) The determination of wave height and wave pattern for waves diffracted by an infinitely long breakwater, or by a backwater gap, has been based on the theoretical solution for optical diffraction. Model tests for wave patterns with two different lengths of breakwater and waves of different steepnesses are described and results presented in a form suitable for application.

1369. Great Lakes Harbors, by Edwin W. Nelson. (WW) This paper discusses improvements in Great Lakes channels and harbors which will be required as a result of the projected completion of the St. Lawrence Seaway. The paper covers both the connecting channels between the lakes as well as harbor channels. Pier and breakwater reconstruction is also discussed.

1370. Operation of Missouri River Main Stem Reservoirs, by R. J. Pafford, Jr. (WW) The paper describes the six main stem multiple purposes reservoir system built under the Pick-Sloan program adopted in 1944. It outlines the main features of operation of these reservoirs in the interest of flood control, irrigation, water supply and sanitation, power, recreation, and fish and wild life. The development of the highly complex operating plans and criteria is discussed.

1371. The City's Place in the Expanded Highway Program, by Alfred Berarducci and Glen C. Richards. (HW) This paper recommends that cities must take the initiative to secure their just participation in the expanded highway program. Two important steps are suggested; that cities must develop a practical highway needs program, and must establish a suitable relationship with their state government to provide the financing for necessary projects.

1372. Direct Solution for a Triple Spiraled Compound Curve, by Alfred C. Scheer. (HW) The analytical solution presented in this paper is believed to be somewhat shorter and more fundamental than the traditional solutions. After the tangent distances of the unspiraled compound curve have been computed, all that remains are a few easy calculations which may usually be done by slide rule with sufficient accuracy.

1373. How to Increase the Productivity of Highway Engineers, by G. I. Sawyer. (HW) There are three vital factors with which State Highway engineers must concern themselves in increasing the productivity of their staffs; namely, personnel, engineering techniques and morale. The effects of these factors are described and evaluated.

1374. Operation of Urban Expressways, by Joseph Barnett. (HW) Urban freeways and parkways often break down at peak volumes, stopping all traffic. This paper explains the reason for such stoppage when caused by too great traffic density, suggests a procedure for analyzing traffic thereon, and proposes that traffic entering expressways be controlled so that volume is kept well below possible capacity to insure free movement.

1375. Hydrostatic Testing of Pipelines, by Leon E. Brooks. (PL) This paper considers hydrostatic testing of pipelines, which has become a principal method of testing for the following reasons: rehabilitation of old systems, increase in pipelines, advances in pipe manufacture, industry reapproval of current codes, and natural advantages of water testing.

1376. Route Surveys for Offshore Pipelines, by Clyde Aldridge. (PL) Route surveys for offshore pipelines present some problems not normally associated with route surveys on land. This paper reviews some of their problems and the equipment and methods used on a 12-in. pipeline laid offshore of the coast of Louisiana.

1377. Discussion of Proceedings Papers 1103, 1236. (IR) R. G. Kazmann closure to 1103. Gordon E. Williams on 1236.

1378. Discussion of Proceedings Paper 1090. (HW) Corrections to discussion by Angel Villasor, Jr.

1379. Climatic Influences on Crop Water Requirements, by Thomas C. Skinner. (IR) In the past decade, water requirements of plants as influenced by climate have received considerable study and experimentation. This paper presents a discussion of the work that has been done in the field of crop water requirements to date, with particular emphasis on work done at the University of Florida in Gainesville, Florida.

1380. The Consulting Engineer's Role in the Highway Program, by Elmer B. Isaak. (HW) Engineering the enlarged Federal Aid highway program is a task which will require all available talent. State highway departments will administer the work, but must supplement their own technical forces with consultants. Consulting engineers must assume a real responsibility, constantly endeavoring to find the best solutions and using their ingenuity to advance the standards of highway building.

1381. Discussion of Proceedings Papers 965, 1119, 1208. (WW) Frank H. Newnam, Jr., closure to 965. S. H. Wearne on 1119. Gerard Tison, Jr. on 1208.

1382. Discussion of Proceeding Papers 809, 1054, 1058, 1096, 1097, 1146, 1147, 1149, 1150, 1151, 1187, 1188, 1189, 1190, 1314. (ST) Committee closure to 809. M. G. Spangler closure to 1054. F. J. Cain and G. Luck on 1058. Otakar Ondra closure to 1058. Henry M. Lummis III on 1097. Edwin W. Thomas on 1146. Yves Nubar on 1147. James H. Shellhammer, Raman Pichumani, and John R. Verna on 1149. A. J. Francis on 1150. Walter M. Zalite on 1151. Howard H. Mullins, Jerry C. L. Chang on 1187. Albert O. Grote, J. V. Du Plessis on 1188. Anthony M. DiGioia on 1189. Reinaldo Garcia-Iturbe on 1190. Raymond Archibald on 1314.

1383. Discussion of Proceedings Papers 1194, 1195. (PL) Corrections to 1194. Henry M. Paynter on 1195.

1384. The Soap Lake Basin, by Keith E. Anderson. (IR) Soap Lake, a natural body of mineralized water without surface outlet, lies within the Columbia Basin Project in Washington. Initial irrigation flows, coinciding with above-normal precipitation, upset the delicate inflow-evaporation balance causing flooding of adjacent areas and dilution of the allegedly therapeutic waters. Inflow-outflow studies permitted estimation of inflows attributable to irrigation.

1385. Significance of Tests for Highway Materials Basic Tests, by Committee on Significance of Tests for Highway Materials, Highway Division. (HW) Tests for highway materials which are considered basic in soils, bituminous materials, and concrete aggregates areas are discussed to include the significance of test results. In addition, synopsis of test method, typical test results, and influences of the method of test are indicated for each test.

1386. Metropolitan Traffic and Highway Problems, by Murray V. Jones. (HW) The Metropolitan Corporation was incorporated in 1953 to solve major problems of the area created by phenomenal growth, uncoordinated municipal planning and a high standard of living. To solve highway and traffic problems, a coordinated transportation administration was created to plan for, construct and operate transportation facilities. After three and one-half years it has been shown that this form of administration provides the most efficient manner in which to solve problems of interrelated communities.

October

1387. The Current National Picture in Urban Renewal, by Richard Steiner. (CP) This

paper presents the national picture in urban renewal on September 30, 1956. It includes over-all facts and figures and touches on progress activities involving engineers. These undertakings include streets and highways, sewerage and drainage projects, flood control, schools, parks, and playgrounds.

1388. Planning Problems in the Washington Metropolitan Area of Virginia, by John E. Woodward, Jr. (CP) Coordinated planning by all communities involved is necessary for solution of problems resulting from the rapid expansion of the Washington metropolitan area of Virginia. The purpose of this paper is to review generally problems facing planners in this area.

1389. On the Dynamic Strength of Rigid-Plastic Beams Under Blast Loads, by Mario G. Salvadori and Paul Weidlinger. (EM) Upper bounds to the dynamic strength of simply supported beams acted upon by a uniformly distributed blast pressure are obtained under the assumption of rigid-plastic behavior in bending and/or in shear (development of "plastic hinges" and/or "plastic slides"). The results of the present analysis are valid for other types of impulsive forces.

1390. Demonstrations of Plastic Behavior of Steel Frames, by H. M. Nelson, D. T. Wright, and J. W. Dolphin. (EM) This paper presents results of full scale tests which were made to illustrate the behavior under load of structures designed by the plastic theory. Plastic analysis of moment redistribution was verified, and sheer, instability, and flange buckling effects were checked.

1391. Turbulence in Civil Engineering: An Introduction to Three Research Papers, by J. M. Robertson. (HY) The relation of the papers to the status of our knowledge and needs in turbulence is indicated through a review of ASCE publications, and a brief summary of the status of the turbulence problem.

1392. Turbulence in Civil Engineering: Measurements in Free Surface Streams, by Arthur T. Ippen and Fredric Raichlen. (HY) Various turbulence phenomena in free surface streams were investigated by means of a combination of a total head tube with a capacitance type pressure transducer. Design criteria for the instrument are given, as well as a series of performances data derived from turbulence measurements.

1393. Turbulence in Civil Engineering: Turbulence in a Diffuser Boundary Layer, by J. M. Robertson and G. L. Calehuff. (HY) Measurements of turbulence intensity and shear in the boundary layer on the inside of a 7½° conical diffuser are reported. Comparison of results with those reported for non-pressure gradient boundary layers indicates significant divergence from the universal inner region concept.

1394. Turbulence in Civil Engineering: Investigations in Liquid Shear Flow by Electromagnetic Induction, by L. M. Grossman, H. Li, and Hans A. Einstein. (HY) The relation of the papers to the status of our knowledge and needs in turbulence is indicated by a review of ASCE publications, and by a brief summary of the status of the turbulence problem.

1395. 100 Frequency Curves of North American Rivers, by E. Kuiper. (HY) This paper presents frequency curves of maximum annual flood flows on important rivers in North America. The frequency curves are drawn as straight lines. It was found that inclination of lines is a function of drainage area, climate, and soil conditions.

1396. Kemano Pressure Conduit Engineering Investigations, by F. L. Lawton and J. G. Sutherland. (PO) This paper considers some aspects of the basic investigations and tests associated with the design of pressure conduits for the world's largest underground hydroelectric generating station.

1397. Penstock Experience and Design Practice, by Gordon V. Richards. (PO) This paper reviews recent penstocks designed by a large west coast utility company and with this as a basis, presents in detail a summary of the company's current design procedures.

1398. Large Spiral Casings of T-1 Steel, by E. L. Seeland. (PO) Four of the largest turbine spiral casings, field welded, will be the first casings to date using T-1 steel, a low-carbon, quenched and tempered alloy plate steel with a high yield strength of 90,000 psi.

1399. Analysis of Continuous Beams by Fourier Series, by Seng-Lip Lee. (EM) This paper deals with analysis of continuous beams by means of expansion of arbitrary load function and intermediate redundant reactions in infinite trigonometric series. The values are determined by application of Castigliano's theorem, and the same procedure is used to derive expressions for influence lines for reactions.

1400. Nuclear Long-Range Fallout in Surface Waters, by Carlos G. Bell, Jr. (SA) Emphasis is placed on measurements for and calculation of runoff coefficients of gross long-range fallout beta radioactivity for several streams in eastern Massachusetts and the Genessee River in New York. Solubility of long-range fallout, its sedimentation, and its rate of dissipation after deposition is examined.

1401. The Hydraulic Design of Stilling Basins: Hydraulic Jumps on a Horizontal Apron (Basin I), by J. N. Bradley and A. J. Peterka. (HY) This paper presents a study of the hydraulic jump with reference to the applicability of the hydraulic jump formula, the length of jump over the entire practical range, and includes a new classification for the various forms of the hydraulic jump.

1402. Hydraulic Design of Stilling Basins: High Dams, Earth Dams, and Large Canal Structures, by J. N. Bradley and A. J. Peterka. (HY) This paper analyzes the critical dimensions of thirty-six existing hydraulic jump stilling basins and hydraulic model verification tests which are used to generalize the design of a stilling basin utilizing chute blocks and an end sill.

1403. Hydraulic Design of Stilling Basins: Short Stilling Basins for Canal Structures, Small Outlet Works, and Small Spillways (Basin III), by J. N. Bradley and A. J. Peterka. (HY) This paper describes tests to generalize the design of a shorter stilling basin containing chute blocks, end sill, and one row of baffle piers. General design rules and sample problems are included. Critical basin dimensions, water surface profiles, and tail water ranges are presented in dimensionless forms.

1404. Hydraulic Design of Stilling Basins: Stilling Basin and Wave Suppressors for Canal Structures, Outlet Works, and Diversion Dams, by J. N. Bradley and A. J. Peterka. (HY) Where the Froude number of incoming flow is low, the hydraulic jump produces objectionable waves downstream. This study generalizes the design of two stilling basins and two types of wave suppressors for stabilizing water surface. Sample problems are used to illustrate design procedures recommended.

1405. Hydraulic Design of Stilling Basins: Stilling Basins with Sloping Apron (Basin V), by J. N. Bradley and A. J. Peterka. (HY) Procedures and rules for the design of a stilling basin with a sloping apron are presented, with a study of the relative merits of sloping and horizontal aprons. Critical basin dimensions and tail water requirements are presented in dimensionless forms. Recommendations are verified from an analysis of thirteen existing basins having sloping aprons.

1406. Hydraulic Design of Stilling Basins: Small Basins for Pipe or Open Channel Outlets—No Tail Water Required (Basin IV), by J. N. Bradley and A. J. Peterka. (HY) A consideration of an impact-type stilling basin developed which will handle 21 to 340 cu ft per sec. General design rules and a table listing critical dimensions and proper riprap sizes for nine different basin sizes are presented.

1407. Sanitary Engineering and Reactor Waste Disposal, by J. G. Terrill, Jr. and M. D. Hollis. (SA) The problem of nuclear reactor waste disposal offers a new challenge to the sanitary engineer. The general nature of reactor wastes, their effect on nature and treatment are discussed.

1408. Dispersal of Pollution by Tidal Movements, by T. M. Niles. (SA) The disposal of sewage into tidal waters has created many problems for the sanitary engineer. Chief among these is the calculation of total load which can be placed upon tidal waters. An approach to this problem is given, with data on the Potomac River and the Delaware River.

1409. Anaerobic Reduction of Manganese in Reservoirs, by John H. Weideman and Robert H. Fetner. (SA) Manganese may appear seasonally in some impoundments when part of the impoundment is anaerobic. One possible source of this manganese may be reduction of insoluble manganese dioxide found in the soil by carbon dioxide produced as an anaerobic by-product of biological metabolism.

1410. Niagara River Pollution, by Raymond W. Hess. (SA) The tremendous industrial development along the Niagara River created a pollution problem that has increased with time. Considerable study has been made into the pollutional problem and its solution. Progress is definitely being made to keep pollution to a minimum.

1411. Liquid Content of Garbage and Refuse, by John S. Wiley. (SA) The optimum moisture (water) content for aerobic composting of organic wastes varies considerably with the type of wastes. Determination of liquid content by a formula is proposed as an analysis more universally applicable than moisture content.

1412. Graphical Solution of Equations of Vibrations, by Wen-Hsiung Li. (EM) A graphical method is presented for analysis of dynamical systems of oscillations described by two simultaneous first-order ordinary differential equations. Examples of application are taken from hydraulic vibrations, including analysis of a differential surge-tank, and of a conduit with two surge-tanks.

1413. The Strength of Very Slender Beams, by E. F. Masur. (EM) The response of slender beams to lateral bending and torsion is analyzed. Large deformations lead to a nonlinear theory, whose strength predictions may deviate greatly from those of conventional linear analysis, especially with regard to redundant bending moments in the major plane of the beam. The theory is corroborated experimentally.

1414. Coexistence of Fish and Dams, by Howard A. Preston and Louis E. Rydell. (PO) This paper outlines the background of the Columbia River salmonoid fishery, the problems of sustaining it in the face of intensifying watershed development, and the need of continued progress toward improvement of the fishery in the light of the program for river development.

1415. Discussion of Proceedings Papers 1073, 1141, 1196. (EM) William Prager closure to 1073. Anatol Roshko on 1141. I. K. Silverman on 1196.

1416. Discussion of Proceedings Papers 948, 1086, 1216, 1285, 1344. (PO) R. T. Richards, E. T. Keck, J. Junget closure to 948. C. P. Lindner, L. F. Johnson closure to 1086. Benjamin Donsky on 1216. Richmond Pearson Hobson, Fritz Heidinger on 1285. Sylvester V. Williams, Fritz Heidinger on 1344.

1417. Discussion of Proceedings Papers 1077, 1114, 1197, 1198, 1199, 1200, 1201, 1202, 1260, 1266, 1277. (HY) Harald Tults closure to 1077. Francis F. Escoffier closure to 1114. Thomas Maddock, Jr. on 1197. E. F. Rice on 1198. T. E. Stelson on 1199. Leo R. Beard, Manuel A. Benson on 1200. Leslie J. Hooper, B. L. VanderBoegh on 1201. E. M. Laursen and A. Toch on 1202. A. Rylands Thomas on 1260. E. A. Elevatorski on 1266. Lloyd C. Fowler and Robert H. Livesey on 1277.

1418. Inelastic Analysis of Eccentrically Loaded Columns, by M. E. Clark, O. M. Sidebottom, and R. W. Shreeves. (EM) This paper presents a theory by which the collapse load of an eccentrically loaded column can be rationally determined. Experimental verification of the theory was obtained from tests made on aluminum alloy rectangular and T-section columns. A study of the effect of time on the magnitude of the collapse load was also made, using SAE 1020 steel columns.

1419. Sir Adam Beck-Niagara Generating Station No. 2, by Frank Dobson. (PO) This paper presents design and construction features of an extension to a hydroelectric power generating station on the Niagara River and its associated works, with particular emphasis on the pump-storage-generating plan used to preserve the scenic spectacle of Niagara Falls.

1420. Fixed-Wheel Gates for Penstock Intakes, by Sylvan J. Skinner. (PO) There is a dearth of published information on actual overall design of high-head flat structural steel fixed-wheel gates used for emergency closure of penstock or other conduit intakes. This paper covers the major design problems and present design treatment by the Bureau of Reclamation, U. S. Department of the Interior, for this type of gate.

1421. The Regulation Chart for Power Computations, by C. P. Lindner. (PO) A rapid method is explained for computing power output and prime flow of a system of reservoirs and power plants. Adjustment of power output and prime flow for leakage and evaporation losses is described, and formulas for economic installation for secondary power are given.

1422. Discussion of Proceedings Papers 928, 1083, 1224. (SA) K. Fraschina on 928. D. E. Bloodgood, W. J. Boegly, and C. E. Smith closure to 1083. Harold E. Babbitt on 1224.

1423. Settling Behavior of Waste Suspensions, by Vaughn C. Behn. (SA) The qualitative mechanism of a settling slurry is set forth with consideration given to experimental equipment used to observe such behavior. The means by which data from such equipment has been analyzed quantitatively is delineated. The application to a sewage sludge is demonstrated.

1424. The Pressure Line and the Inelastic Buckling of Columns, by Frank Baron and Harold S. Davis. (EM) The pressure line concept developed for the elastic behavior of frames is extended to studies of the inelastic behavior of such structures and of eccentrically and laterally loaded columns.

1425. Redevelopment of Providence, Rhode Island, by Donald M. Graham. (CP) With federal assistance, the Providence Redevelopment Agency has effectuated a slum clearance project for a neighborhood, a small industrial redevelopment project, a large industrial redevelopment project, a neighborhood renewal project, and is presently improving community facilities that will serve the entire city.

November

1426. Chemical Grouting: Progress Report of the Task Committee on Chemical Grouting of the Committee on Grouting of the Soil Mechanics and Foundations Division. (SM) This report is divided into the following sections: injection processes, injection procedures, summary of field applications, patent abstracts, and annotated bibliography; describing all chemical processes known to the committee. The chemical composition of all grouts are given, where available, and where possible, the reaction involved with each grout.

1427. Thixotropic Characteristics of Compacted Clays, by H. B. Seed and C. K. Chan. (SM) Previous investigations of thixotropic effects in saturated clays are summarized, and thixotropic effects in compacted clays and their variation with soil composition is demonstrated. Test data is presented and effects of thixotropy on results of tests are examined.

1428. Laterite Soils and Their Engineering Characteristics, by K. S. Bawa. (SM) This paper gives a review of existing literature concerning the origin, distribution, and physical properties of laterite soils, and includes an evaluation from a civil engineering point of view.

1429. Geologic Investigations of Dam Sites by the SCS, by Gunnar M. Brune. (SM) The role of geologists in the Soil Conservation Service, particularly in connection with its dam building program, is examined. Types of drilling equipment used, organization of parties, and costs of drilling are dealt with. Geologic reports and laboratory analyses are also examined.

1430. Discussion of Proceedings Papers 941, 1079, 1081, 1159, 1160, 1161, 1204, 1205, 1299, 1309. (SM) No closure notice to 941. C. I. Mansur and R. I. Kaufman closure to 1079. Bramlette McClelland and John A. Focht, Jr. closure to 1081. J. F. Redus closure to 1159. Robert L. McNeill and Raymond Lundgren on 1160. Yoshichika Nishida on 1161. Judson P. Elston, Glebe A. Kravetz on 1204. J. D. Hodgson, C. Y. Li on 1205. W. Watters Pagon on 1299. H. Y. Fang on 1309.

1431. Torsion Analysis for Suspension Bridges, by Nan sze Sih. (ST) Equations are derived in this paper to determine stresses in stiffening trusses due to torsion, considering cable interaction and the effect of warping. Equations derived may also be used to determine certain constants for analysis of dynamic loads.

1432. A Simplified Design of Composite Bridge Stringers, by Jack C. Hacker. (ST) Equations for an approximate direct design of balanced composite steel stringers for ordinary highway bridges are presented in this paper. Numerical examples for the three basic types of steel stringers are worked out.

1433. Wood Diaphragms: Progress Report of a Sub-Committee of the Committee on Timber Structures of the Structural Division. (ST) Reduction of exterior structural walls by modern fenestration and omission of fixed partitions necessitates accurate engineering design to provide requisite strength and stiffness of wood-framed buildings, especially for lateral loads. This report is a digest of current technical information and a bibliography of sources regarding the engineering properties of wood-sheathed diaphragms.

1434. The Design of Rigid Frame Bents, by Richard Z. Zimmermann, Jr. (ST) This paper, demonstrating contemporary design procedures for indeterminate structures, is a comparison of three methods of solution available to the structural designer for determination of bending moments and shears in an unsymmetrical rigid frame bent subjected to a concentrated vertical load.

1435. Grit and Shot-Reinforced High Tensile Bolted Joints. by R. L. Sanks and C. C. Rampton, Jr. (ST) This paper considers the effect of paint in high tensile bolted joints and of grit and shot placed between painted contact surfaces. It is demonstrated that shot-reinforced painted joints are, in static tests, equal to or somewhat better than clean mill-scale joints and much superior to riveted joints.

1436. Deas Island Tunnel, by Per Hall, Troels Brondum-Nielsen, and H. R. Kivisild. (ST) The Deas Island Tunnel, under the Lower Fraser River at Vancouver, introduces to this continent the use of a trench type reinforced concrete four-lane traffic tunnel of rectangular cross section supported on sandfill jetted in place. Engineering and structural design of the tunnel, and approach structures are described.

1437. Analysis of Helical Beams under Symmetrical Loading, by Alan M. C. Holmes. (ST) Thorough analysis of moments and deflections of a helical beam is simplified by consideration of the symmetrical case, and relationship between design variables and behavior of structure is shown. Tables and curves are presented for members of rectangular section, showing the greater structural efficiency and smaller deflection of shallower members.

1438. Garrison Dam—Tunnel Test Section Investigation, by Harris H. Burke. (SM) These two papers describe an extensive six-year investigation of tunnel loading in a large (36-ft diameter) tunnel test section at Garrison Dam, including application of results to the eight prototype tunnels, and observations on their initial performance.

1439. Garrison Dam—Evaluation of Results from Tunnel Tests Section, by K. S. Lane. (SM) This paper describes the principal methods employed in evaluating the observations from the large tunnel test section, and major results. New analytical methods are presented, and their possible application is examined.

1440. Effect of Initial Eccentricities on Column Performance and Capacity, by John M. Hayes. (ST) This paper summarizes results of tests made on the effect of initial eccentricities on column performance and capacity. The rolled H-section of ASTM A7 structural steel was investigated.

1441. Elastic Structures with Nonlinear Load-Deflection Curves, by Benjamin M. Ma. (ST) This paper presents the essential characteristics of the action of a simple structure in practical use for which the linear stress-strain relation results in a nonlinear load-deflection curve, involving a region where the load decreases with increase in deflection.

1442. Discussion of Proceedings Papers 1106, 1189, 1233, 1234, 1254, 1255, 1303, 1316, 1318. (ST) Robert M. Barnoff closure to 1106. Anthony M. DiGioia on 1189. John E. Goldberg, Kenneth H. Lenzen, R. A. Williamson, Zdenek Sobotka, E. Neil W. Lane on 1233. DeForest A. Matteson, Jr. on 1254. Masso Naruoka, Benjamin C. F. Wei on 1255. Masso Naruoka on 1303. T. Au on 1316. Masso Naruoka on 1318.

1443. Electric Analog for Level-Net Adjustment, by Hsuan-Loh Su. (SU) A method is suggested, using the analogy between the electrical network and the level net, for adjustment of a level net. Calculation methods are simple, and results are automatically checked.

1444. Electronic Computers in Surveying Operations, by Arthur J. McNair. (SU) Examples of computing both routine and more elaborate problems by use of electronic digital computers in surveying operations are given. Opportunities for new concepts in the teaching of surveying by use of an electronic computer are described.

1445. Distance Measurement with the Geodimeter and Tellurometer, by John S. McCall. (SU) The practical uses of the measurement of distances by electronic means are pre-

sented in this paper. Some of the applications would include rapid measurement of lines of a triangulation net, traverse in rough country or over bodies of water, and coastal hydrograph surveys.

1446. Surveying and Mapping, St. Lawrence Power Project, by John D. Officer. (SU) The agencies developing the St. Lawrence Power Project solved many surveying and mapping problems while obtaining detailed topographic and property maps, and establishing horizontal and vertical control for structures. Each agency had a different method of accomplishing the same coordinated results.

1447. A Meteorological Method for Profile Surveying, by L. V. Toralballa. (SU) This paper derives a hydrodynamic equation similar to that which underlies the method generally known as Airborne Profile Recording, but one that is free from the assumption that the wind is geostrophic. An aircraft is made to fly along an isobar and certain atmospheric measurements are taken enroute, as well as at the ends of the trajectory and on the two ground points.

1448. Discussion of Proceedings Paper 1064. (SU) E. D. Morse closure to 1064.

December

1449. The Hydraulic Jump at an Abrupt Drop, by Walter L. Moore and Carl W. Morgan. (HY) The role of the drop in determining the form of the drop and in stabilizing its position is clarified by analysis and experiment. Application of results is illustrated by examples.

1450. Transition from Laminar to Turbulent Flow in a Pipe, by M. R. Carstens. (HY) Transition from laminar to turbulent flow was observed during flow establishment in a smooth, straight pipe. Turbulent spot formation was in qualitative agreement with the Tollmein-Schlichting theory of small disturbances.

1451. Flood Frequencies Derived from Rainfall Data, by Joseph L. H. Paulhus and John F. Miller. (HY) A long record of peak discharges may be synthesized for any basin having a streamflow record of sufficient length to derive a unit hydrograph and to test a rainfall-runoff relation.

1452. Flow Characteristics on the Ogee Spillway, by Robert B. Jansen. (HY) A simple formula is developed for determining energy loss on an overflow spillway face. A criterion for establishing the pattern of velocity variation along a level spillway apron is considered.

1453. Discharge Characteristics of Rectangular Thin-Plate Weirs, by Carl E. Kindsvater and Rolland W. Carter. (HY) A solution for discharge characteristics of rectangular, thin-plate weirs is based on a simple equation of discharge, and experimentally derived coefficients. The solution is compared with other experiments and formulas.

1454. Air Binding in Large Pipelines Flowing Under Vacuum, by R. T. Richards. (HY) This paper examines the phenomenon of air binding and methods of control, with emphasis on the accumulation of air in sloping pipes.

1455. Flow Through Circular Weirs, by J. C. Stevens. (HY) This paper presents a formula for theoretical flow through sharp crested circular weirs, involving use of elliptic functions.

1456. Discussion of Proceedings Papers 1015, 1082, 1165, 1201, 1260, 1264. (HY) J. C. Stevens closure to 1015. Aly Fathy and Aly Salem Shukry closure to 1082. H. Alden Foster closure to 1165. Robert T. Knapp on 1201. Alvin J. Peterka, Alfred C. Ingersoll, S. Leliavsky on 1260. Alvin J. Peterka on 1264.

1457. Design of Large Pressure Conduits in Rock, by F. W. Patterson, R. L. Clinch, and I. W. McCaig. (PO) This paper presents a review of theoretical principles and design assumptions which influence design and describes design, fabrication, and construction of pressure conduits for three developments in Canada.

1458. Factors in Selection of Pieve Di Cadore and Fedaia Dams, by Carlo Semenza. (PO) The procedure followed by a large operating company in Italy in selecting the type of dam best suited to a given locality is described.

1459. Water Resources and Water Developments in Alabama, by Melvin R. Williams. (PO) The water resources of Alabama are evaluated and increasing demands on the supply made by growth and development of the state are described.

1460. Discussion of Proceedings Papers 1184, 1267, 1344, 1350. (PO) Maurice R. Scharff on 1184. William T. Moody on 1267. Carlos S. Ospina on 1344. Carlos S. Ospina on 1350.

1461. Vortex Flow Through Horizontal Orifices, by J. C. Stevens and Richard C. Kolf. (SA) Practical use has been made of vortex flow in combined sewers. For a vigorous vortex, the coefficient of discharge may be as low as 10%.

1462. Fiscal Operations of the Buffalo Sewer Authority, by Frederick W. Crane. (SA) This paper describes the fiscal phases of operation of a metropolitan sewerage system under a public authority organization.

1463. Effect of Local Weather on Air-Pollution Problems, by A. L. Danis. (SA) Valid findings in the study of an air-pollution problem can be made only from local meteorological data. Five cases showing effects of local weather on diffusion of air-borne pollutants are examined.

1464. Sodium Metaphosphate Glass in Water Treatment, by David H. Howells. (SA) This paper provides, by a review of literature and field practices, information regarding sodium metaphosphate glass requisite to its effective utilization by the sanitary engineer.

1465. Lake Intakes, by Carl W. Reh. (SA) The problem of locating water intakes in the Great Lakes poses problems from both a hydraulic and a sanitary viewpoint. Design considerations for lake intakes, and operating histories of several lake intakes are given.

1466. Discussion of Proceedings Papers 1274, 1335, 1337. (SA) R. N. Roberts on 1274. Ralph Stone on 1335. Ralph Stone on 1337.

1467. Opening Remarks, by Mason G. Lockwood. (AT) This paper is a presentation of

the purposes behind the Jet Age Airport Conference, summarizing its current problems and intents.

1468. Orientation, by Joseph D. Blatt. (AT) This paper examines the responsibility of the civil engineer in planning air terminals to meet requirements imposed by the introduction of turbine powered aircraft into the civil air fleets.

1469. Civil Jet Transport Noise, by Donald A. Buck. (AT) Three years of testing with the Boeing 707 Prototype has provided data on jet engine sound suppressor development and noise considerations. Test results indicate that jet transports can be integrated into world-wide airline systems.

1470. Operational Characteristics of the Douglas DC-8, by J. B. Edwards. (AT) This paper considers planning of aircraft for the jet age, gives a description of the Douglas DC-8, and describes operational capabilities of this aircraft on and around air terminals.

1471. Convair 880 Airport Operations, by A. D. Riedler. (AT) This paper describes the forthcoming Convair 880 jet transport due for airline operation in 1960. Operation at the air terminal and a statement on ground service is presented. Illustrations detail dimensions, range, and power plants, among others.

1472. Jet Age Planning, by James T. Pyle. (AT) This paper examines problems brought up by the impending use of jet transports. Such matters as traffic control, servicing facilities, and certification of jets are treated.

1473. Traffic Estimates and Airport Economics, by Kenneth A. Osterberg. (AT) Airport expenses are a major item of air transportation costs. Terminals should be planned to use space frugally and to avoid overbuilding. Traffic forecasts will assist designers by showing the space required.

1474. Protection of Airport Approaches, by Chester G. Bowers. (AT) Studies on the operating of turbo-prop and turbojet commercial aircraft show that these aircraft do not create new problems regarding obstructions to air navigation. No changes are contemplated by the Civil Aeronautics Administration for determining obstructions to air navigation because of the use of jet aircraft in civil aviation.

1475. Jet Transport Ground Handling, by Donald B. Talmage. (AT) Variations in ground service requirements for the new jet and turbo-prop aircraft are examined. Features of some of the more radical proposals are summarized.

1476. Airports, Planes and People, by William L. Pereira. (AT) The purpose of the jet age airport and passenger is yet to be fully recognized. The master planner and the air industry must design a dynamic, integrated ground complex whose purpose is accommodating the planes and passengers of tomorrow's air travel.

1477. A Statistical Approach to Runway Length, by Ralph T. Glasson. (AT) This paper examines the statistical nature of variables affecting takeoff runway length. Effect of variation on payload, climatological factors, and airplane performance is covered. The need for individual analysis of each airport is stressed.

1478. Airport Configuration, by W. E. Cullinan, Jr. (AT) This paper considers adjustments which are possible in layouts of existing airports to improve efficiency and release areas for building development or expansion. The relationship between runway pattern and airport capacity is also examined.

1479. Effects of Jet Blast and Fuel Spillage on Bituminous Pavements, by W. J. Turnbull and Charles R. Foster. (AT) Studies conducted by the Corps of Engineers for the U. S. Air Force show the critical effects of jet blast and fuel spillage on tar concrete, asphaltic concrete, and rubberized-tar concrete pavements.

1480. USAF Airfield Pavement Problems in the Jet Age, by George W. Leslie. (AT) A review of the experience of the U. S. Air Force with airfield pavements for military jet aircraft is presented for the benefit of commercial operators who will be concerned with providing paved facilities for commercial jet aircraft.

1481. The Jet Age Airport and its Neighbors, by Charles E. Rosendahl. (AT) Airport community problems incident to civil jet aircraft operations are presented in this paper. Noise and vibration problems in the vicinity of air terminals will change as jet aircraft are introduced.

1482. Fueling U. S. Air Force Aircraft, by George B. Seeley. (AT) Fueling systems required by modern jet aircraft are markedly different from those required by the aircraft of World War II. Development of the multiple-outlet system and the filter-meter hose carts is outlined with emphasis placed on the necessity for providing fool-proof operation.

1483. Airport Master Planning for the Jet Age, by Herbert H. Howell. (AT) Continuous increases in air traffic are forecast resulting in greater loads on our airports system. Communities must plan for the future on a system concept because of the interdependence of all airports in the system.

1484. Approach and Runway Lighting for Jet Age Aircraft, by Howard J. Fry. (AT) This paper covers testing of airfield approach lighting systems. Special emphasis is placed on strobeacon and flush lighting units.

1485. Discussion of Proceedings Paper 1480. (AT) Frank H. Gardner, Carlton H. Bascom on 1480.

1486. Professional Earnings and Satisfaction Survey of Civil Engineers: Report of the Junior Activities Committee, Kansas City Section, ASCE. (BD) A survey was undertaken by the Junior Activities Committee to reveal conditions of satisfaction with employment and salary within the membership of the Kansas City Section. The results have been plotted to indicate those conditions by age of employee, type of work, and by employer group.

1487. Engineers and Unions: Report of a Special Committee of the Junior Member Forum of the San Francisco Section, ASCE. (BD) The purpose of this report is to examine the relationship between engineers and unions, emphasizing the problem of unionization and collective bargaining for engineers.

1488. Circulating Water Systems of Steam Power Plants, by R. T. Richards. (PO) The

need for reliability and economy in circulating water systems justifies careful hydraulic design. This paper examines some hydraulic features which require special attention.

1489. Computer Studies of Penstock and Governor Systems, by Eldo C. Koenig and Howard A. Knudtson. (PO) A high-speed electronic differential analyzer is used to solve equations describing dynamic characteristics of a hydroelectric generating system.

1490. Economic Advancement Objectives, Final Report of the Task Committee on Study of Economic Advancement Objectives of the Board of Direction. (BD) This report is submitted by the task committee which was established by the Board of Direction to make a complete new study and investigation as to what the Society can do to improve the economic status of its members.

1491. Tomorrow's Engineering Problems, by C. C. Furnas. (BD) The solutions of old problems frequently create new problems. The new engineering problems concern the use of our natural resources.

1492. Divided Flow Through a Divergent Inlet Conduit, by Stavros Tsakonas. (HY) This investigation is concerned with the determination of the characteristics of divided flow phenomena. Two models have been analytically and experimentally investigated.

1493. Abstracts and Index to Proceedings, Volume 83, (1957) (BD) A list of abstracts and a subject and author index have been prepared for all Proceedings Papers published in 1957; the numbers covered are 1136 to 1492. The subject headings used were taken from the names of the technical divisions of the Society; other headings were added when deemed necessary. By use of the author index, it is possible to trace all the discussions that a paper has received.

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The technical papers published in the past year are identified by number below. Technical-division sponsorship is indicated by an abbreviation at the end of each Paper Number, the symbols referring to: Air Transport (AT), City Planning (CP), Construction (CO), Engineering Mechanics (EM), Highway (HW), Hydraulics (HY), Irrigation and Drainage (IR), Pipeline (PL), Power (PO), Sanitary Engineering (SA), Soil Mechanics and Foundations (SM), Structural (ST), Surveying and Mapping (SU), and Waterways and Harbors (WW), divisions. Papers sponsored by the Board of Direction are identified by the symbols (BD). For titles and order coupons, refer to the appropriate issue of "Civil Engineering." Beginning with Volume 82 (January 1956) papers were published in Journals of the various Technical Divisions. To locate papers in the Journals, the symbols after the paper numbers are followed by a numeral designating the issue of a particular Journal in which the paper appeared. For example, Paper 1113 is identified as 1113 (HY6) which indicates that the paper is contained in the sixth issue of the Journal of the Hydraulics Division during 1956.

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c. Discussion of several papers, grouped by Divisions.

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